



Royal Flying Doctor Service
WESTERN OPERATIONS

Clinical Manual

Part 1 Clinical Guidelines

Version 9.1

May 2019

Royal Flying Doctor Service Western Operations
3 Eagle Drive, Jandakot Airport, Western Australia 6164

T 61-8-9417 6300

F 61-8-9417 6319

E medical@rfdswa.com.au

Clinical Manual - Part 1 - Clinical Guidelines

Version 9.1

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Introduction

Purpose of the Manual

This manual is an aid to the clinical management and aeromedical transport of patients by RFDS Western Operations (RFDSWO). It has been developed as a multi-disciplinary document for the use of all RFDSWO Retrieval Doctors and Flight Nurses.

Structure

The manual is divided into five parts, each of which contains reference material which may be of use before or during flight. It is not intended as a comprehensive coverage of all topics but as a ready reference for doctors and nurses when access to more detailed references may not be available. The parts are as follows:

- Part 1 Clinical Guidelines
- Part 2 Drug Infusion Guidelines
- Part 3 Procedures
- Part 4 Standard Drug List
- Part 5 Standard Aircraft Minimum Equipment List

Part 1 - Clinical Guidelines

These are guides to the pre-flight and in-flight management of various cases. They are intended to cover conditions not commonly encountered for which specific treatment is required (for example, paraquat poisoning), as well as common problems for which we have developed standard guidelines for management (for example, preterm labour). Definitive management of patients always remains the responsibility of the appropriate RFDSWO Doctor.

On occasions Flight Nurses may encounter unexpected medical problems. Advice should always be sought from an RFDSWO doctor by telephone or aircraft radio. However, in the event that communication is not possible, these clinical guidelines should be used. Flight Nurses must always practise within the scope of RFDSWO Flight Nurse Competency Standards and RFDSWO Nursing Practice Standards. Emergency actions in accordance with these clinical guidelines that are within the scope of the individual's medical or nursing practice, will be endorsed by the Head of Medical and the Head of Nursing.

Part 2 - Drug Infusion Guidelines

This section provides information on commonly used drug infusions. The particulars of preparation are appropriate to the range and volumes of drugs and intravenous fluids carried on our aircraft. Infusions cover those settings which do not have syringe drivers but only volumetric pumps. Simple tables minimise the calculations required in flight. Further information related to Drug Infusion Guidelines can be found in the Introduction to that section.

Part 3 - Procedures

This part contains brief notes and guidelines for procedures that may need to be carried out by RFDS Doctors or Flight Nurses. These guidelines are aimed to provide brief, practical advice on procedures and do not preclude variations based on the individual practitioner's experience and assessment of the case. Flight Nurses are authorised to carry out procedures that are identified in the RFDSWO Flight Nurse Competency Standards.

Part 4 – Standard Drug List

This part outlines the minimum standard drugs which should be available for any patient transport flight conducted by RFDS Western Operations. The list covers the most common emergency and routine drugs and the minimum quantities required for flights from any region of the State. The list is a balance between coverage of a diverse range of potential clinical needs and the provision of

an excessive choice of agents. Additional drugs or extra quantities of drugs may be carried for specific cases.

Part 5 – Standard Aircraft Equipment List

This section lists the minimum equipment on each aircraft, irrespective of the different storage options and configuration of different aircraft types.

Updates

The manual is distributed to all RFDS Flight Nurses and Medical Officers with additional reference copies kept at each Base and one in each aircraft. Printed copies are controlled documents. Electronic versions are also available on the RFDS national website and the Western Operations intranet. Other electronic versions may be made available.

Updates and new guidelines will be provided at intervals. With each set of update pages, a new Table of Contents will be provided indicating the appropriate contents. The manual is a dynamic document with continuing additions and revisions.

Validity

Pages in this document will remain valid indefinitely unless otherwise updated or deleted.

Errors and Modifications

Despite our best efforts, typographical and other errors can occur. Clinical staff are requested to notify the Head of Medical Services of any errors noted so that they may be rectified.

The manual is by nature a dynamic document and needs to be constantly reviewed in light of changing clinical practice. Staff are encouraged to submit suggested additions, deletions, or modifications to the Head of Medical. The manual and its contents are reviewed on an ongoing basis by the Clinical Advisory Committee.

Disclaimer

These notes are issued as a guide only. Whilst all care is taken to ensure they are accurate and complete, reference should be made to standard textbooks of treatment or to the manufacturer's written drug or equipment information, where any discrepancy exists.

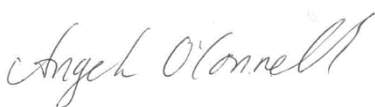
This manual has been prepared solely for the use of RFDSWO personnel and RFDSWO takes no responsibility for the consequences of any use (authorised or unauthorised) by other persons. This manual remains the property of RFDSWO and should not be copied or distributed without the consent of the Head of Medical,

Reference

This manual has been compiled using the principles outlined in the publication 'A guide to the development, implementation and evaluation of clinical practice guidelines' published by the NHMRC, 1999.

Acknowledgement

This manual has had multiple contributors. However I wish to particularly acknowledge the considerable work by Prof. Stephen Langford in compiling and editing the contents of previous versions of the Clinical Guidelines.



Head of Medical

1 March 2019

Abbreviations and Units of Measure

Use of abbreviations has been minimized wherever possible. However the following standard clinical abbreviations and units of measure are used.

Units of Measure

mL	millilitres	mEq	milliEquivalents
L	Litres	IU	International Units
mg	milligrams	mmol	millimoles
µg	micrograms (or mcg)	min	minute
g	grams	hr	hour
kg	kilograms	J	Joules
mm	millimetres	1%	1 g per 100mL
cm	centimetres	g/L	grams per Litre
km	kilometres	mL/hr	millilitres per hour

Clinical Terminology

AAA	Abdominal aortic aneurysm	CT	Computerised tomogram
ABG	Arterial blood gas	CTG	Cardiotachography
ACEI	Angiotensin converting enzyme inhibitor	CTPA	Computerised tomography pulmonary angiogram
ACR	Albumin creatinine ratio	CVA	Cerebrovascular accident
ACS	Acute coronary syndrome	CVC	Central venous catheter
AF	Atrial fibrillation	CVP	Central venous pressure
AFB	Acid fast bacilli	CXR	Chest x-ray
ALS	Advanced life support	DBP	Diastolic blood pressure
APH	Antipartum haemorrhage	DC	Direct current
APO	Acute pulmonary oedema	DIC	Disseminated intravascular coagulopathy
ARDS	Adult respiratory distress syndrome	DKA	Diabetic keto-acidosis
ATLS	Advanced trauma life support	DVT	Deep vein thrombosis
BBB	Bundle branch block	EAR	Expired air resuscitation
BP	Blood pressure	ECG	Electrocardiogram
Bpm	Beats per minute	EMST	Early management of severe trauma
BSL	Blood sugar level	ENT	Ear nose and throat
BVM	Bag valve mask	ERCP	Endoscopic retrograde cholangiopancreatography
CAPD	Continuous ambulatory peritoneal dialysis	ETCO ₂	End-tidal CO ₂
CCP	Casualty Clearing Post	ETT	Endotracheal tube
Cf	Compared with	FAB	Antibody fragment
CK	Creatine kinase	FBC	Full blood count
CNS	Central nervous system	FFP	Fresh frozen plasma
CPAP	Continuous positive airway pressure	FHR	Foetal heart rate
CPR	Cardiopulmonary resuscitation	F _i O ₂	Fraction of inspired oxygen
CSF	Cerebrospinal fluid	FM	Foetal movements
CSL	Compound sodium lactate	GCS	Glasgow coma score

GIT	Gastrointestinal tract	NSTEACS	Non ST elevation acute coronary syndrome
GPS	Global positioning system	OT	Operating theatre
GTN	Glyceryl trinitrate	PO	Per oral
Hb	Haemoglobin	pPlat	Plateau pressure
Hct	Haematocrit	PPV	Positive pressure ventilation
HELLP	Haemolysis, Elevated Liver enzymes, Low Platelet count	PR	Per rectum
HFNC	High Flow Nasal Cannulae	P _a CO ₂	Partial pressure arterial carbon dioxide
HR	Heart rate	P _a O ₂	Partial pressure arterial oxygen
IA	Intra-arterial	P _B	Barometric pressure
IBP	Invasive blood pressure	PTCA	Percutaneous transluminal coronary angioplasty
ICC	Incident Control Centre	PCO ₂	Partial pressure carbon dioxide
ICP	Intracranial pressure	PE	Pulmonary embolism
IDC	Indwelling catheter	PEA	Pulseless electrical activity
IDDM	Insulin dependent diabetes mellitus	PEEP	Positive end expiratory pressure
IM	Intramuscular	PIB	Pressure Immobilization Bandage
INR	International normalised ratio	PO ₂	Partial pressure oxygen
IO	Intraosseous	PPE	Personal protective equipment
IPPV	Intermittent positive pressure ventilation	PPH	Post partum haemorrhage
IU	International units	PRBC	Packed red blood cells
IUGR	Intrauterine growth retardation	PRC	Packed red cells
IV	Intravenous	PSVT	Paroxysmal supraventricular tachycardia
JVP	Jugular venous pressure	PT	Prothrombin time
KCl	Potassium chloride	PV	Per vaginum
LAD	Left anterior descending coronary artery	RBBB	Right bundle branch block
LBBB	Left bundle branch block	ROSC	Return of spontaneous circulation
LFT	Liver function tests	RR	Respiratory rate
LMA	Laryngeal Mask Airway	RSV	Respiratory syncytial virus
LMWH	Low Molecular Weight Heparin	RUQ	Right upper quadrant
LVF	Left ventricular failure	Rx	Treatment
MAP	Mean arterial pressure	SAH	Subarachnoid haemorrhage
MC&S	Microscopy, culture and sensitivity	S _a O ₂	Saturation
MCI	Mass Casualty Incident	SBP	Systolic blood pressure
MI	Myocardial infarction	SC	Subcutaneous
MILS	Manual In Line Stabilisation	SIRS	Systemic Inflammatory Response Syndrome
MRSA	Methicillin resistant staphylococcus aureus	S _p O ₂	Oxygen saturation
NGT	Nasogastric tube	SROM	Spontaneous rupture of membranes
NIBP	Non-invasive blood pressure	SVT	Supraventricular tachycardia
NIV	Non invasive ventilation	T	Temperature
NM	Neuromuscular	tds	Three times a day
NSAIDS	Non-steroidal anti-inflammatory drugs	U&E	Urea and electrolytes

UL	Upper limb
URTI	Upper respiratory tract infection
V/Q	Ventilation / perfusion
VF	Ventricular fibrillation
VT	Ventricular tachycardia
VUJ	Vesico-ureteric junction
WBCT	Whole Blood Clotting time
XR	X-ray

Agencies/Other

ARCBS	Australian Red Cross Blood Service
CASA	Civil Aviation Safety Authority
DFES	Department of Fire and Emergency Services
MIMMS	Major Incident Medical Management and Support Course
OCP	Office of the Chief Psychiatrist
SHICC	State Health Incident Control Centre
WATAG	Western Australian Therapeutics Advisory Group

1 LIFE SUPPORT

1.1 Basic Life Support Flow Chart

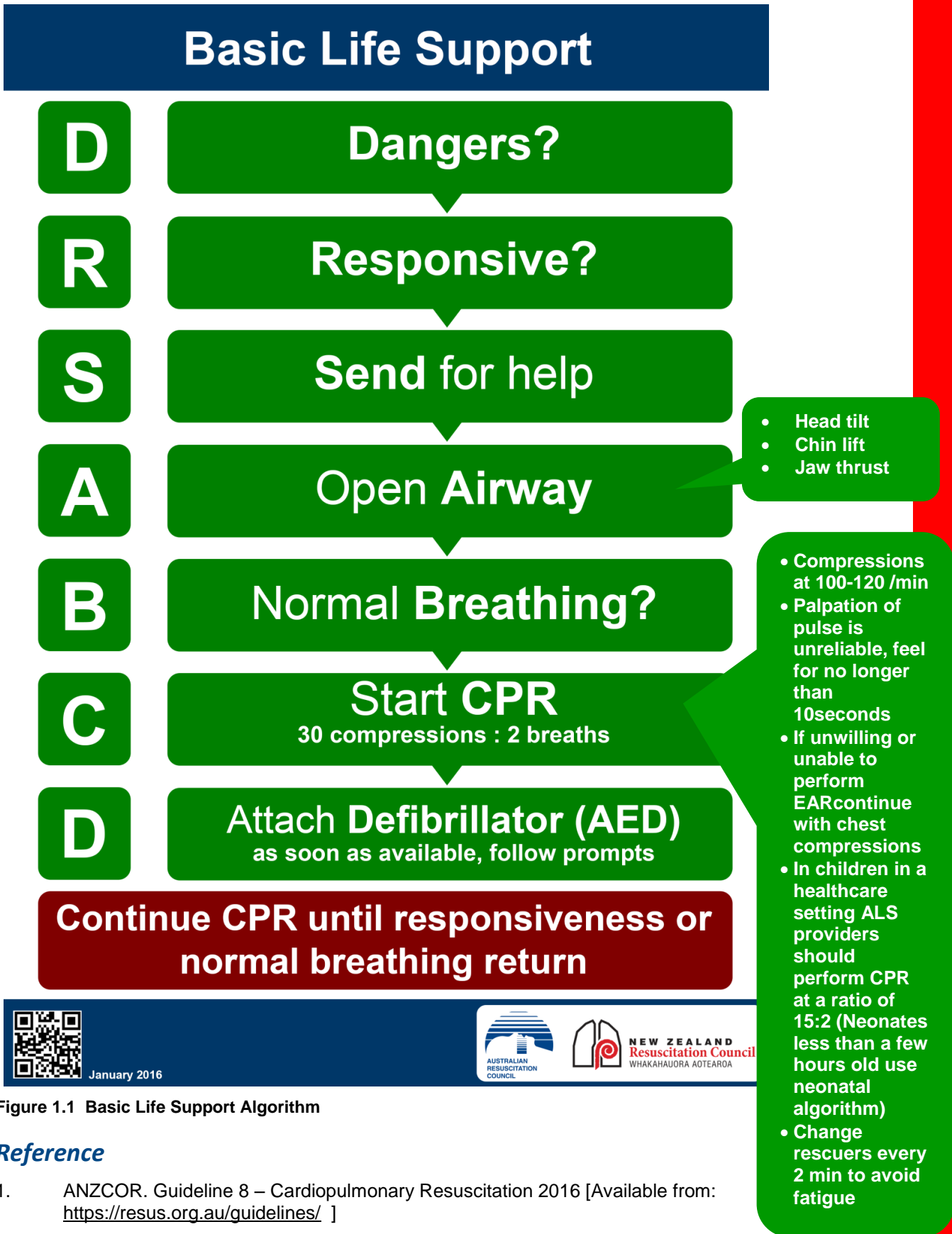


Figure 1.1 Basic Life Support Algorithm

Reference

1. ANZCOR. Guideline 8 – Cardiopulmonary Resuscitation 2016 [Available from: <https://resus.org.au/guidelines/>]

1.2 Newborn Life Support Flow Chart

If more than a few hours old see *Advanced Life Support (Paediatric)*

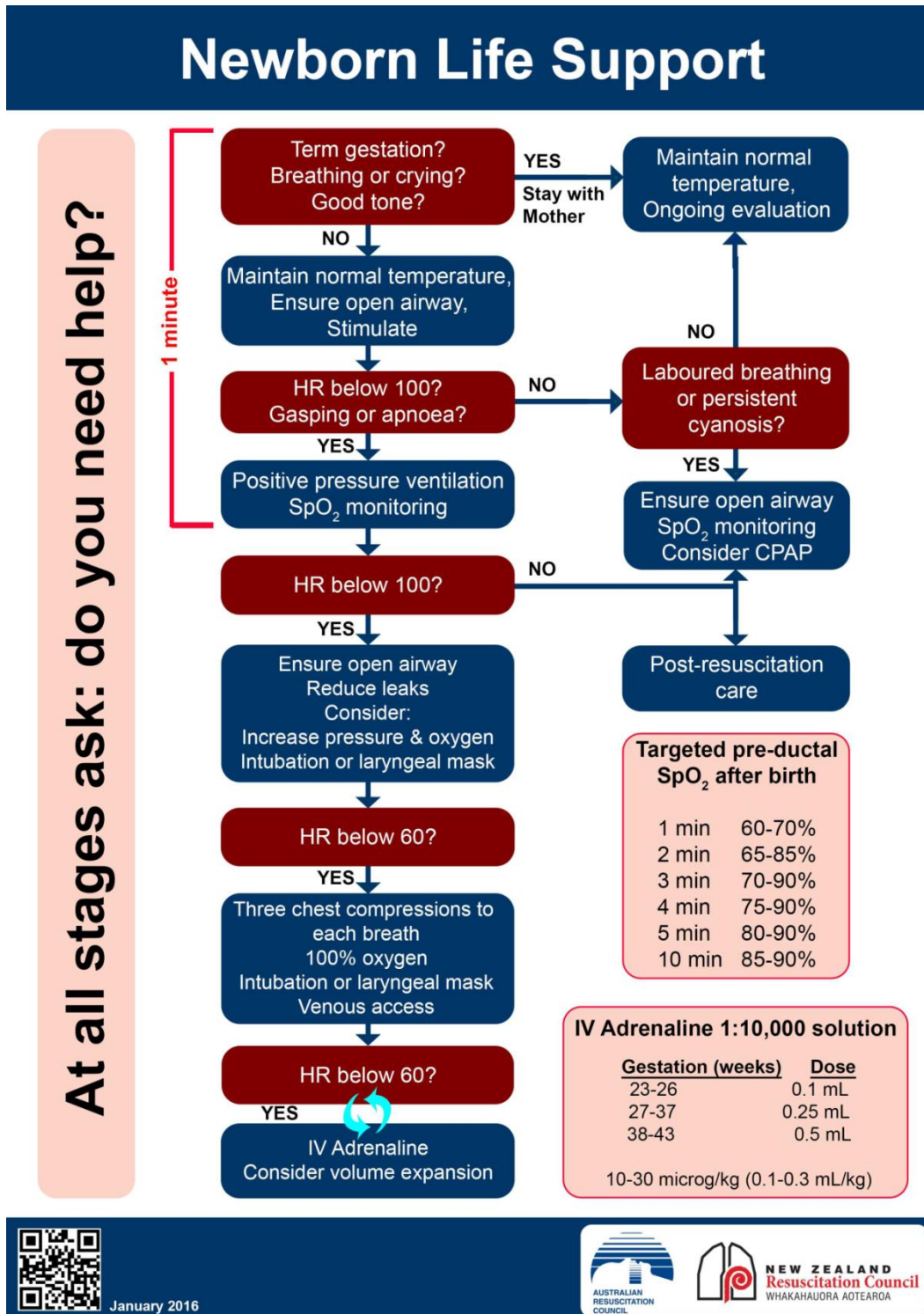


Figure 1.2 Neonatal Life Support Algorithm

Reference

1. ANZCOR. Section 13 – Neonatal Guidelines 2016 [Available from: <https://resus.org.au/guidelines/>]

1.3 Advanced Life Support (Adult)

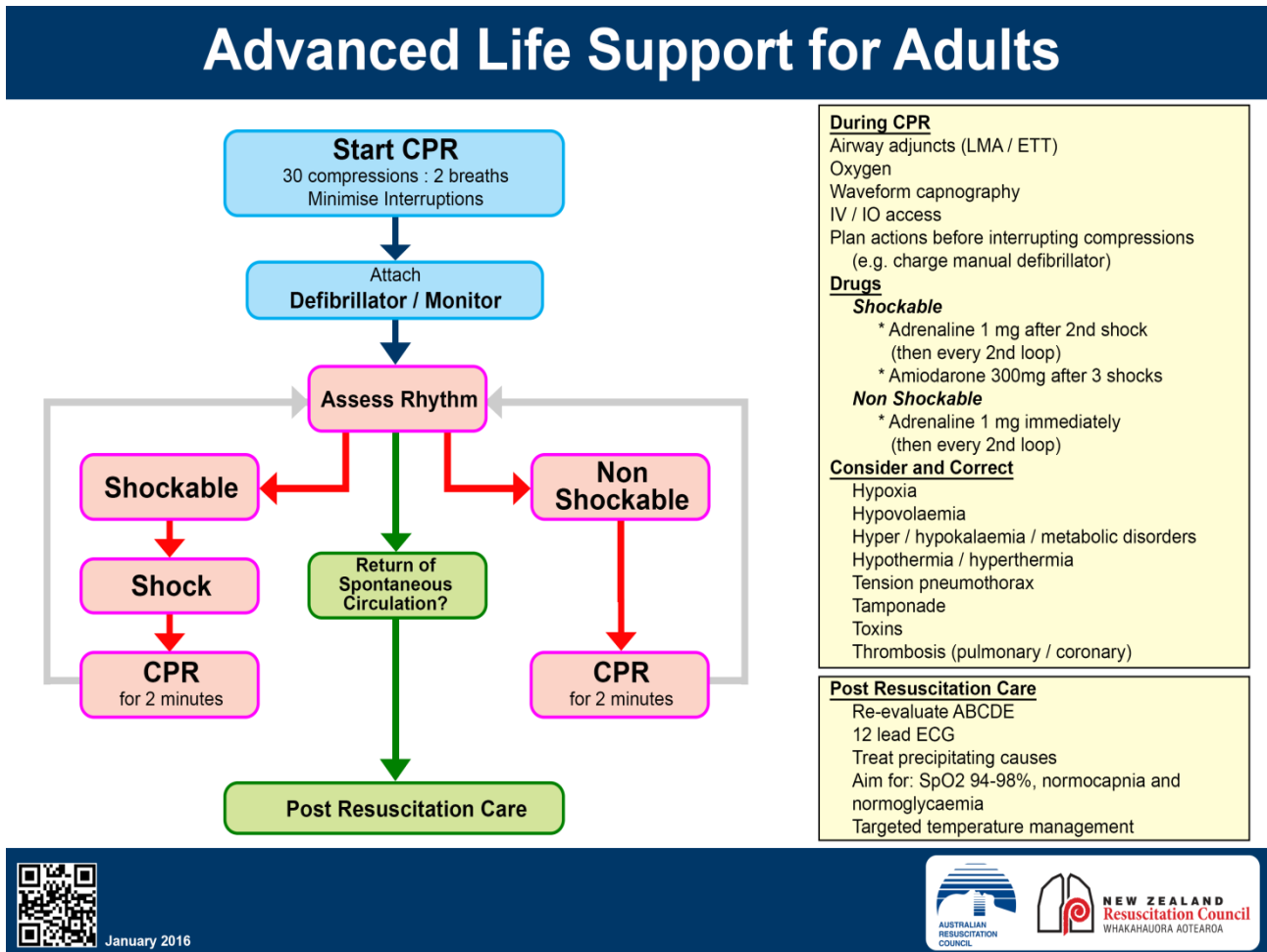


Figure 1.3 Advanced Life Support (Adult)

Advanced Life Support (Adult) - Cont.

Notes

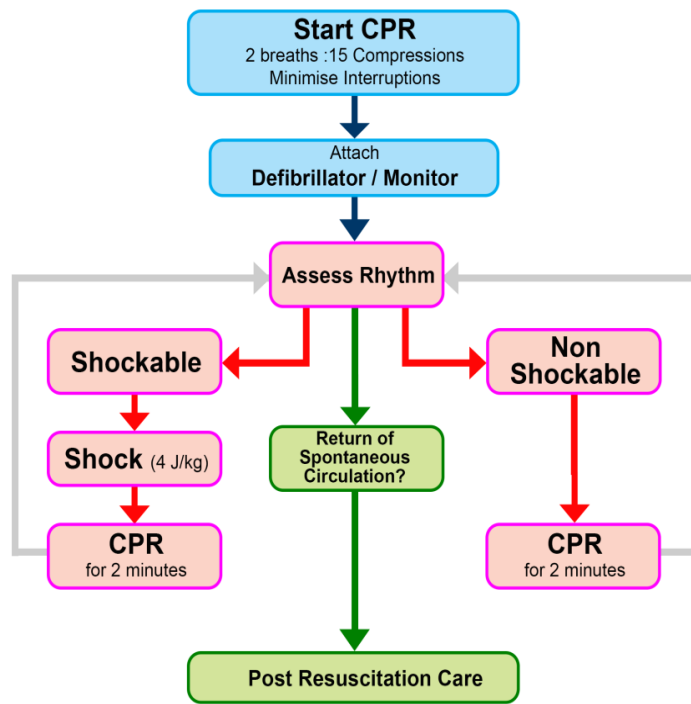
1. Best evidence is for uninterrupted good quality CPR and early defibrillation, other interventions including drugs of less proven value.
2. To minimise interruptions, continue CPR whilst charging machine, charge as approaching end of 2 min cycle, stand clear only whilst shock is delivered. Single shocks only.
3. Return to CPR immediately after delivering a shock unless signs of life (breathing / moving), do not waste time checking rhythm or for a pulse. Rhythm checks at two minutely intervals.
4. Shockable rhythms are ventricular fibrillation and pulseless ventricular tachycardia.
5. Energy levels; Monophasic 360J, Biphasic default energy 200J, unless manufacturer's clear evidence for less. Note All RFDS defibrillators are biphasic.
6. Advanced airways (ETT, LMA) not required if successful BVM ventilation. If in place commence continuous chest compressions with no interruptions for ventilation (i.e. asynchronous ventilation). Securing advanced airway must not result in significant interruption to chest compressions and may be deferred to post resuscitation care.
7. Use ET CO_2 to confirm ETT placement, monitor ventilation & quality of CPR, and as an early indicator of ROSC. Low levels of ET CO_2 may represent excessive PPV or inadequate CPR.
8. There is no evidence for routinely giving buffers, atropine, calcium and magnesium in cardiac arrest. These drugs may be considered when treating potentially reversible causes of cardiac arrest.
 - a) Ca^{2+} (10mL of 10% calcium gluconate or 5-10mL of 10% calcium chloride) for hyperkalemia, hypocalcaemia, calcium channel blocker overdose.
 - b) Mg^{2+} (5mmol) for torsades de pointes, digoxin toxicity, refractory VT / VF, hypokalemia, hypomagnesaemia.
 - c) K^+ (5mmol) for persistent VF due to hypokalemia (in addition to giving Mg^{2+}).
 - d) Sodium bicarbonate (1mmol/kg = 1mL/kg of 8.4% solution) for hyperkalaemia, tricyclic overdose, documented metabolic acidosis or protracted >15mins cardiac arrest.

Reference

1. ANZCOR. Section 11 – Adult Advanced Life Support 2016 [Available from: <https://resus.org.au/guidelines/>]

1.4 Advanced Life Support (Paediatric)

Advanced Life Support for Infants and Children



During CPR
 Airway adjuncts (LMA / ETT)
 Oxygen
 Waveform capnography
 IV / IO access
 Plan actions before interrupting compressions
 (e.g. charge manual defibrillator to 4 J/kg)

Drugs
Shockable
 * Adrenaline 10 mcg/kg after 2nd shock
 (then every 2nd loop)
 * Amiodarone 5mg/kg after 3 shocks

Non Shockable
 * Adrenaline 10 mcg/kg immediately
 (then every 2nd loop)

Consider and Correct
 Hypoxia
 Hypovolaemia
 Hyper / hypokalaemia / metabolic disorders
 Hypothermia / hyperthermia
 Tension pneumothorax
 Tamponade
 Toxins
 Thrombosis (pulmonary / coronary)

Post Resuscitation Care
 Re-evaluate ABCDE
 12 lead ECG
 Treat precipitating causes
 Re-evaluate oxygenation and ventilation
 Targeted Temperature Management



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Figure 1.4 Advanced Life Support (Paediatric)

Advanced Life Support (Paediatric) - Cont.

Notes

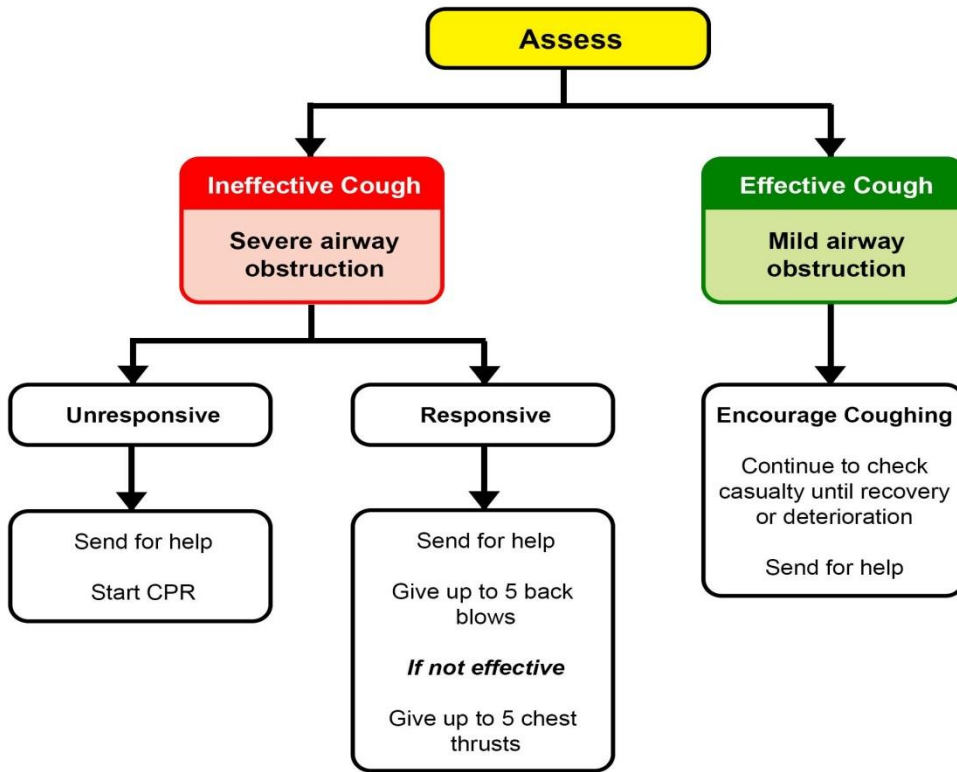
1. Highest priority is good quality CPR with minimal interruptions. NB: different ratio of compressions to ventilations reflects importance of hypoxia as cause of arrest.
2. Return to CPR immediately after delivering a shock/dumping the charge unless signs of life (breathing/moving). Do not waste time checking rhythm or for a pulse.
3. Most paediatric arrests are asystole then PEA (pulseless electrical activity) secondary to hypoxia and hypovolaemia. Shockable rhythms are uncommon.
4. Rhythm checks are at two minutely intervals. If a shockable rhythm, continue CPR whilst charging machine, charge as approaching end of 2 min cycle, stand clear only whilst shock is delivered. Single shocks only to be delivered
5. Energy levels: Monophasic 4J/kg & Biphasic 4J/kg. Note All RFDS defibrillators are biphasic.
6. Advanced airways (ETT, LMA) not required if successful BVM ventilation. If an ETT is in place commence continuous chest compressions with no interruptions for ventilation (i.e. asynchronous ventilation), not applicable with LMA. Securing advanced airway must not result in significant interruption to chest compressions and may be deferred to post resuscitation care.
7. Use ET_{CO}₂ to confirm ETT placement & inadvertent extubation, as well as monitor ventilation & quality of CPR, and as an early indicator of ROSC. Low levels of ET_{CO}₂ may represent excessive PPV or inadequate CPR.
8. There is no evidence for routinely giving buffers, atropine, calcium and magnesium in cardiac arrest. These drugs may be considered when treating potentially reversible causes of cardiac arrest.
 - i. Ca²⁺ (0.7mL/kg max 20mg/kg of 10% calcium gluconate or 0.2mL/kg of 10% calcium chloride) for documented hypocalcaemia & hyperkalemia and calcium channel blocker overdose.
 - ii. Mg²⁺ (0.1-0.2mmol/kg) for torsades de pointes or hypomagnesaemia, followed by an infusion of 0.3mmol/kg over 4 hours
 - iii. K⁺ (0.03-0.07mmol/kg injection or 0.2-0.5mmol/kg/hr infusion) for hypokalemia.
 - iv. Sodium bicarbonate (0.5-1mmol/kg = 0.5-1mL/kg 8.4% solution) for severe metabolic acidosis or prolonged arrest
9. Neonates less than a few hours old refer to [Newborn Life Support Flow Chart](#)

References

1. ANZCOR. Section 12 – Paediatric Advanced Life Support 2016 [Available from: <https://resus.org.au/guidelines/>]
2. ANZCOR Guideline 12.2 – Advanced Life Support for Infants and Children: Diagnosis and Management. March 2016
3. ANZCOR Guideline 12.4 – Medications and Fluids in Paediatric Advanced Life Support. August 2016
4. ANZCOR Guideline 12.6 – Introduction to Paediatric Advanced Life Support Techniques in Paediatric Advanced Life Support. January 2016
5. Advanced Paediatric Life Support: A Practical Approach to Emergencies, Sixth Edition Australia and New Zealand. Edited by Martin Samuels and Sue Wieteska. Published 2017 by John Wiley & Sons Ltd. Chapter 20: Management of Cardiac Arrest p199-207

1.5 The Choking Child

Foreign Body Airway Obstruction (Choking)





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Figure 1.5 Foreign Body Airway Obstruction (Choking)

1.6 Resuscitation under Special Circumstances

Theory

Resuscitation techniques may need to be modified in some conditions.

Pregnancy

A good outcome for the foetus is dependent on good care of the mother. In cardiac arrest, all the principles of basic and advanced life support apply. Specific additional factors include:

1. Displacement of the uterus to the left, either manually or by pelvic tilt, is necessary in order to relieve aortocaval compression. High quality chest compressions must still be possible in this position
2. Chest compressions may need to be deeper and in a higher position in order to compensate for anatomical changes in pregnancy.
3. Consider preparation for emergency peri-mortem Caesarean section within 5 mins of cardiac arrest, if initial resuscitation efforts are unsuccessful. This is to aid resuscitation of the mother.

Trauma

Unless the injury is obviously unsurvivable, resuscitation should be attempted. The majority of preventable deaths from trauma are most likely due to haemorrhage, and so the priorities are as follows:

1. **Stop external haemorrhage** by necessary means (direct pressure, tourniquet, pelvic binder/splint)
2. Open & maintain airway, give 100% O₂ and exclude easily treatable causes such as tension pneumothorax with finger thoracostomy.
3. Rapid vascular access and restoration of circulating blood volume, ideally with blood products if available (following massive transfusion protocol) or 20mLs/kg crystalloid fluid
4. Open (clamshell) thoracotomy for drainage of pericardial tamponade is preferable to pericardiocentesis but limited by practical considerations in the transport environment, and less likely to be of use in blunt trauma than penetrating.
5. Chest compressions take second priority to the above, as they are ineffective on an empty heart and may possibly be detrimental by causing increased bleeding or cardiac tamponade.

Pre-flight & In-flight Management

If an AED is available at scene, this should be used. Advise the personnel to follow the prompts and ensure safety.

Fatigue from chest compressions occurs quickly, and if other personnel are available, the compression role should be swapped as often as possible, to ensure ongoing good quality CPR.

There are significant limitations to undertaking effective CPR in the aircraft. Safety of the crew is paramount. Diversions to a Regional Emergency Department for essential resources/back up can be considered.

References

1. ANZCOR Guideline 11.10.1: Management of Cardiac Arrest due to Trauma. April 2016
2. ANZCOR Guideline 11.10 – Resuscitation in special circumstances. November 2011
3. WOMEN AND NEWBORN HEALTH SERVICE King Edward Memorial Hospital – CLINICAL GUIDELINES Newborn Health Service – EMERGENCY PROCEDURES Resuscitation In Late Pregnancy. Last Amended February 2015.

1.7 The Deteriorating Patient

Theory

At all times during the patient transport, from pre-flight assessment to handover of the patient at the receiving end, it is important to recognise and act appropriately to signs of deterioration in the patient. Deterioration can nearly always be anticipated, such that a clearly defined action plan needs to be pre-determined for such events and supported by communication between staff.

For our purposes deterioration may either be physiological or behavioural, but in either case an escalation of care may be required. Predictors of deterioration may be evident from the time of the pre-flight assessment, become evident whilst the patient is awaiting transport or occur during transport. The timing of deterioration will to a certain extent determine what actions may be required.

Physiological predictors of deterioration

In the remote and rural retrieval setting we are heavily reliant on simple parameters and clinical acumen to determine risk of deterioration. Many of these parameters also form the basis of the more complex scoring systems for escalation such as Medical Emergency Response (MER) and Early Warning Score (EWS). Trends in observations are much more useful than single values.

The following table is a reminder of what parameters may require an escalation in care:

Table 1.1 Physiological Predictors of Deterioration

	<3 months	4-12 months	1-4 years	5-11 years	12-18 years	Adult
Nurse, Doctor or parent worried	✓	✓	✓	✓	✓	✓
Airway threat	✓	✓	✓	✓	✓	✓
Hypoxaemia	SpO ₂ < 95%	SpO ₂ < 95%	SpO ₂ < 95%	SpO ₂ < 95%	SpO ₂ < 95%	SpO ₂ < 90%
Respiratory distress, apnoea, cyanosis	✓	✓	✓	✓	✓	✓
Respiratory rate	>65 <25	>55 <25	>50 <20	>35 <15	>30 <10	>25 <10
Heart rate	<100 >170	<90 >170	<80 >150	<70 >140	<50 >130	<40 >110
Hypotension	SBP <50	SBP <60	SBP <70	SBP < 80	SBP <90	SBP <90
Acute change in neurological status, convulsion	Sudden fall in level of consciousness, GCS drop >2 points. Repeated or extended seizures, or 1st seizure.	Sudden fall in level of consciousness, GCS drop >2 points. Repeated or extended seizures, or 1st seizure.	Sudden fall in level of consciousness, GCS drop >2 points. Repeated or extended seizures, or 1st seizure.	Sudden fall in level of consciousness, GCS drop >2 points. Repeated or extended seizures, or 1st seizure.	Sudden fall in level of consciousness, GCS drop >2 points. Repeated or extended seizures, or 1st seizure.	Sudden fall in level of consciousness, GCS drop >2 points. Repeated or extended seizures, or 1st seizure.

Escalation of care may comprise any number of the following actions:

1. Increase in priority of flight.
2. Doctor accompaniment.
3. Seeking additional orders, from RFDS doctor or clinical coordinator.

4. Diverting in flight for a higher level of assistance or resources (e.g. to collect an RFDS doctor, transfer patient to regional hospital emergency department, acquire additional supplies like blood products). Diversions ideally should be facilitated by the clinical coordinator.
5. Additional recommendations regarding pre-flight stabilisation (e.g. intubation, commencement of inotrope or other therapies).
6. Planning to go in to a facility to stabilise a patient rather than have them brought out to the airport.
7. Planning a different destination for the patient (e.g. an ICU bed)
8. Requesting a lights and sirens ambulance escort.

Predictors of Behavioural Disturbance

In-flight violence or behavioural disturbance is clearly a safety issue made all the more acute by the uncontrolled environment in which we work. It can usually be anticipated as it occurs after a period of mounting tension, and therefore the risk of violence can be reduced. Every effort must be made to ensure the right personnel and appropriate chemical and physical restraints are available where required.

Behavioural disturbance may occur for psychiatric, organic and criminal reason. Whatever the cause, the pilot has an obligation to ensure the safety of the aircraft and is legally entitled to request restraint of a patient or passenger where necessary. Medical authorisation for this restraint is not a pre-requisite, rather an aviation safety duty of care if directed by the pilot. Patients referred under the Mental Health Act (2015) will generally already have medical authorisation for physical restraint in-flight.

Warning signs:

- Provocative, angry behaviour with verbal threats or gestures
- Face & body language e.g. tense posturing, fist clenching, pacing
- Increased volume of speech
- Poor communication and eye contact
- Unclear thought processes, poor concentration, violent or commanding delusions/hallucinations
- Overt suspiciousness, hostility, irritability
- Any behaviour similar to previous violent episodes
- Physiological evidence of over-arousal (tachycardia, tachypnoea, muscle twitching, dilated pupils)

Risk factors:

- History of violent behaviour ←
- Alcohol or drug abuse ←
- Reports of violence from carers or expression of intent to harm
- Previous use of weapons
- Previous dangerous impulsive acts & denial of them
- Known personal trigger factors
- Evidence of severe recent stress
- Poor compliance with treatment
- Specific personality traits & disorders (antisocial, explosive, impulsive)

Biggest risk factors for recurrent violent behaviour.

In addition, all agitated patients, particularly those suffering from delirium and dementia, may be worsened by an unfamiliar environment and night-time conditions.

Escalation of care:

1. Ensure adequate history of behaviour warning signs and risk factors is taken during pre-flight assessment
2. Ensure adequate pre-flight sedation is given including appropriate antipsychotics for patients suffering from psychotic illness.
3. Doctor accompaniment
4. Additional escorts (e.g. police, cooperative relative)
5. Use of physical restraints
6. Ensure basic needs attended to i.e. nutrition, hydration, toileting
7. Observe for and treat drug, alcohol and nicotine withdrawal

Nursing staff seeking assistance with either physiological or behavioural deterioration – follow ISOBAR principles:

- State clearly who and where you are.
- State clearly what the current issue/problem is and your level of concern e.g. “the patient is violently resisting restraint and threatening to kill me. I am extremely worried for my safety” or “the patient has severe abdominal pain with a pulse of 140 and systolic BP of 80. I’m really worried and think they might be bleeding”.
- Give a pertinent & concise background of the patient.
- State clearly what action you want to follow e.g. “I want orders for more sedation, I want a doctor on the flight or I want a doctor to meet us when we land”.
- Confirm what action will be taken, and what is Plan B.

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1.8 Post Resuscitation Care Checklist

Theory

Ventilation

- Target normocarbida. The cerebral vasoconstriction caused by hyperventilation may produce potentially harmful cerebral ischaemia¹.
- Hyperventilation increases intrathoracic pressure, which will decrease cardiac output both during and after CPR².
- Avoid hypoventilation, hypoxia and hypercarbia could increase ICP or compound metabolic acidosis, which is common shortly after ROSC (Return of spontaneous circulation)³.
- Avoid hyperoxia, evidence suggests that hyperoxia during early stages of reperfusion harms post-ischaemic neurons by causing excessive oxidative stress⁴. Ventilation with 100% oxygen for the first hour after ROSC may result in worse neurological outcome compared with immediate adjustment of F_iO₂ to produce an arterial oxygen saturation of 94-96%⁵.
- When inducing therapeutic hypothermia, additional blood gases may be helpful to adjust tidal volumes, because cooling will decrease metabolism and the tidal volumes required³. Blood gas values can either be corrected for temperature or left uncorrected.

Haemodynamic optimisation

- Haemodynamic instability is common after cardiac arrest and manifests as dysrhythmias, hypotension, and low cardiac index⁶. Underlying mechanisms include intravascular volume depletion, impaired vasoregulation, and myocardial dysfunction.
- Dysrhythmias can be treated by maintaining normal electrolyte concentrations and using standard drug and electrical therapies³. There is no evidence to support the prophylactic use of anti-arrhythmic drugs after cardiac arrest.
- Dysrhythmias are commonly caused by focal cardiac ischaemia, and early reperfusion treatment is probably the best anti-arrhythmic therapy.
- The first-line intervention for hypotension is to optimize right-heart filling pressures by using intravenous fluids⁶. Inotropes and vasopressors should be considered if haemodynamic goals are not achieved despite optimized preload³.

Targeted Temperature Management (TTM)

- TTM should be part of a standardised treatment strategy for comatose survivors of cardiac arrest³.
- Induction: with intravenous ice-cold fluids (30mL/kg of saline 0.9% or Ringer's lactate)⁷ or traditional ice packs placed on the groin and armpits and around the neck and head. In most cases it is easy to cool patients initially after ROSC because their temperature normally decreases within the first hour. Initial cooling is facilitated by concomitant neuromuscular blockade with sedation to prevent shivering.
- Complications:
 - Shivering is common, particularly during the induction phase⁸.
 - Increased systemic vascular resistance, which reduces cardiac output.
 - A variety of arrhythmias may be induced by hypothermia, but bradycardia is the most common⁹.
 - Hypothermia induces a diuresis and coexisting hypovolaemia will compound haemodynamic instability. Diuresis may produce electrolyte abnormalities including

hypophosphatemia, hypokalaemia, hypomagnesemia and hypocalcemia and these, in turn, may cause dysrhythmias. The plasma concentrations of these electrolytes should be measured frequently and electrolytes should be replaced to maintain normal values³.

- Hypothermia decreases insulin sensitivity and insulin secretion, which results in hyperglycaemia¹⁰. This should be treated with insulin.
- Effects on platelet and clotting function account for impaired coagulation and increased bleeding.
- Hypothermia can impair the immune system and increase infection rates.
- The clearance of sedative drugs and neuromuscular blockers is reduced by up to 30% at a temperature of 34°C¹¹.
- Magnesium sulphate, a naturally occurring NMDA receptor antagonist, reduces shivering thresholds and can be given to reduce shivering during cooling¹². Magnesium is also a vasodilator, and therefore increases cooling rates¹³. It has anti-arrhythmic properties, and there are some animal data indication magnesium provides added neuroprotection in combination with hypothermia¹⁴.

Despite new data indicating there may be little added benefit from cooling to 33°C as opposed to 36°C¹⁵, current guidelines still advocate active cooling. If complications occur at lower temperatures (32-34°C), the more conservative end point of 36°C should be aimed for¹⁶.

Pyrexia must be prevented. The risk of poor neurological outcome increases for each degree of body temperature >37°C¹⁷.

Control of seizures

Seizures or myoclonus or both, occur in 5-15% of adult patients who achieve ROSC, and 10-40% of those who remain comatose¹⁸. No studies directly address the use of prophylactic anticonvulsants drugs after cardiac arrest, but anticonvulsants such as thiopental, phenytoin, propofol and benzodiazepines all have a role to play in preventing seizure activity. There is no proven benefit to one over the other. Boluses of neuromuscular blocking agents are preferred over continuous infusions to allow for detection and treatment of seizure activity in the absence of continual EEG monitoring³.

Treat ACS

Coronary artery disease is present in the majority of out-of-hospital cardiac arrest (OHCA) patients¹⁹. In patients resuscitated from OHCA, ECG changes may be difficult to interpret due to both false positive and false negative results. Combined/extended ECG criteria for the selection of patients with likely AMI provided excellent sensitivity (100%), and comprise of ST-elevation and/or depression and/or LBBB and/or non-specific wide QRS and/or RBBB²⁰.

Glucose control

Hyperglycaemia is common after cardiac arrest, and should be treated with an insulin infusion. Post-cardiac arrest patients may be treated optimally with a target range of up to 8mmol/L²¹

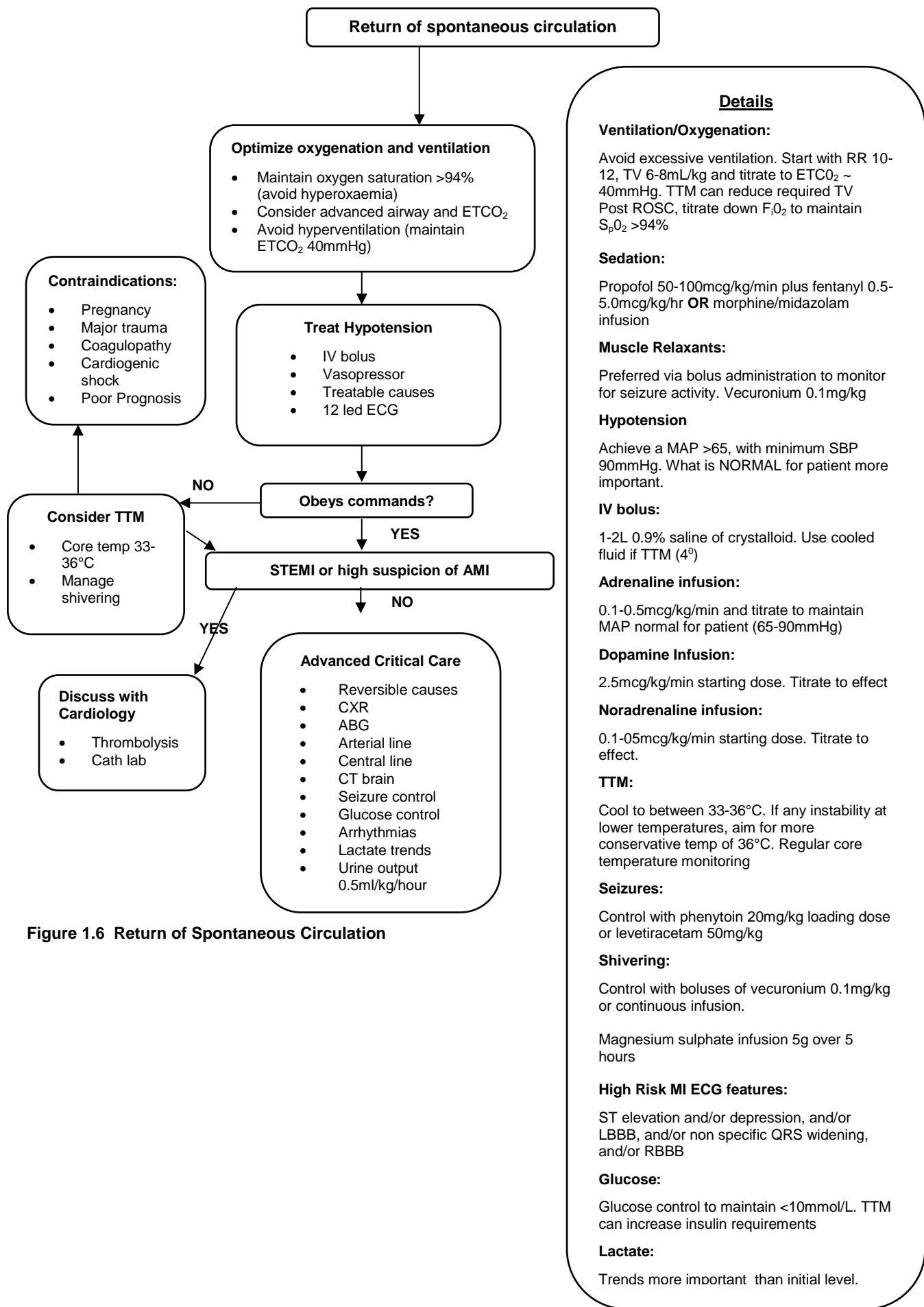


Figure 1.6 Return of Spontaneous Circulation

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1.9 Code Black - Duress Call

Theory

Code Black is a national emergency code, based on Australian Standard (AS) 4083 - 2010 Planning for Emergencies - Health Care Facilities.

Code Black at RFDS can be used in the very rare event of significant personal threat or assault on a crew member inside the aircraft and, when called, it triggers responses in approved procedures. Using the words "Code Black" signals to the pilot the need to get to safety as quickly as possible.

Clinicians are expected to complete the online training provided, the following is a summary:

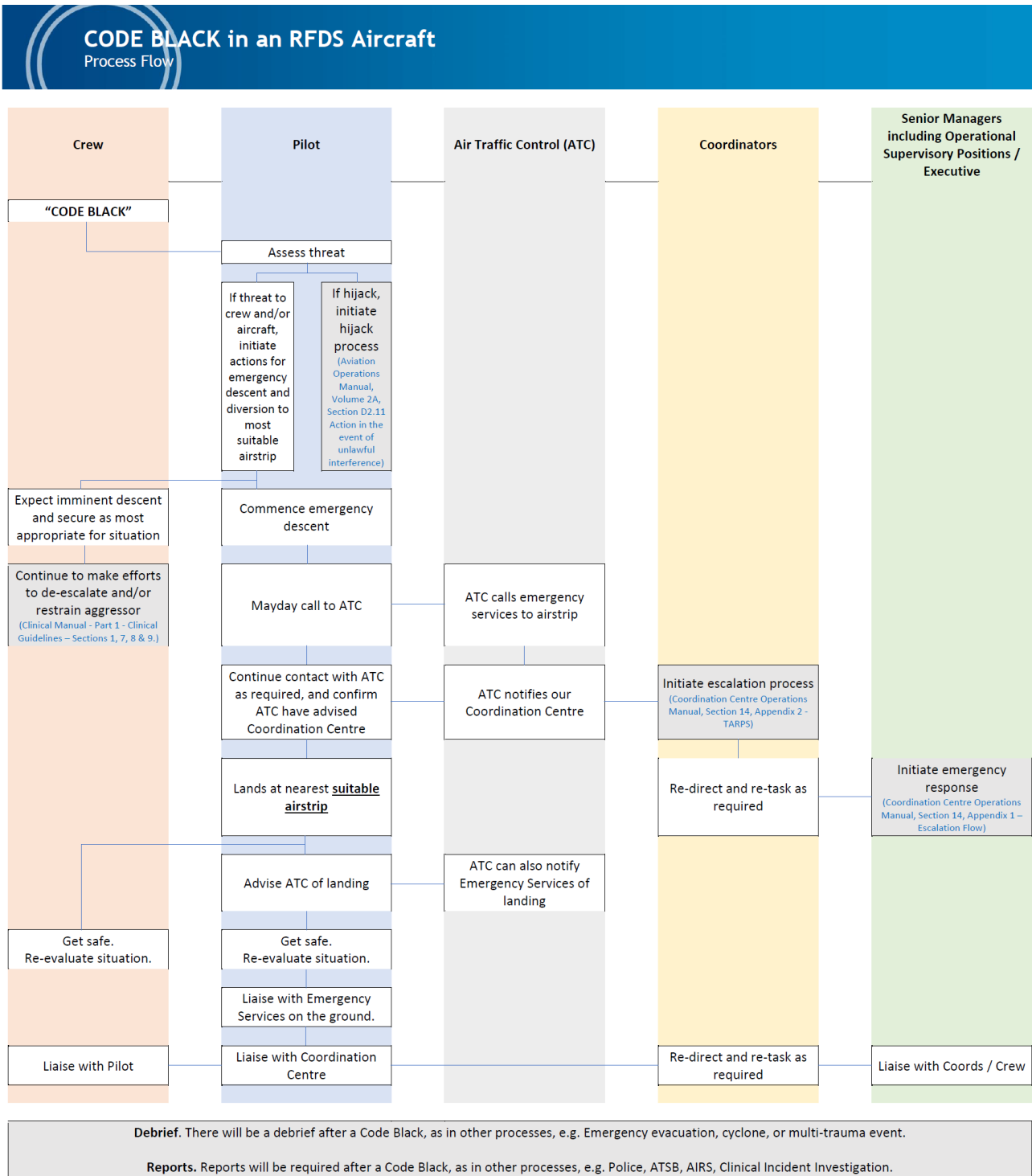


Figure 1.7 Code Black – Process Flow

2 CARDIOVASCULAR

2.1 Acute Coronary Syndromes

Theory

1. Acute Coronary Syndromes (ACS) cover a broad spectrum of acute presentations of ischaemic heart disease. This guideline covers the management of both ST Elevation Myocardial Infarction (STEMI) and Non-ST Elevation Acute Coronary Syndromes (NSTEMI).
2. ACS place a significant burden on health services and retrieval systems. Accurate diagnosis and consistency in management strategies are vital to appropriate use and equitable distribution of limited resources.
3. The diagnosis is based on history, 12 lead ECG findings and for NSTEMI, a serum Troponin. Current clinical care standards state all patients with chest pain or suggested ACS should receive an ECG and assessment of the ECG **within 10 minutes of first clinical contact**. This will not always be possible in the remote and rural setting.

STEMI

Consistent history plus any of the following:

- Persistent ST elevation ≥ 1 mm in 2 contiguous limb leads
- Persistent ST elevation ≥ 2 mm in 2 contiguous chest leads
- New left bundle branch block (LBBB)
- Changes consistent with posterior infarct (tall R in V1, deep anterior ST depression, ST elevation in V4 R)
- ECG changes of right ventricular infarct (ST elevation in leads aVR and V4R)

NSTEMI (includes NSTEMI and Angina)

Consistent history without ECG changes consistent with STEMI, plus positive troponin. Risk stratification as per table:

Table 2.1 Physiological Predictors of Deterioration

Risk Classification	Clinical Characteristic	Management
Extreme	Total occlusion of Left Main Coronary Artery: <ol style="list-style-type: none"> ECG <ul style="list-style-type: none"> • ST elevation in aVR +/- aVL • Lesser ST elevation in V1 • Marked ST depression in inferior leads +/- left anterior fascicular block May present with cardiogenic shock, significant ventricular arrhythmias or cardiac arrest. Very high mortality Total occlusion of proximal left Anterior Descending Coronary Artery (LAD) (Wellen's Syndrome) <ul style="list-style-type: none"> • ECG – prominent T wave inversion in V1-V6. (Mostly V1-V4) 	Urgent Percutaneous Intervention (PCI)

Very High	<ul style="list-style-type: none"> • Haemodynamic instability • Life threatening arrhythmia or cardiac arrest • Recurrent or ongoing ischaemia (refractory to medical treatment), or recurrent dynamic ST and or T wave changes, particularly with intermittent ST elevation, de Winter T wave changes or Wellen's syndrome, or widespread ST elevation in two coronary territories 	Immediate angiography / revascularisation (within 2 hours)
High	<ul style="list-style-type: none"> • Rise and / or fall in troponin level consistent with MI • Dynamic ST segment and / or T wave changes with or without symptoms • GRACE score >140 	Early angiography / revascularisation (within 24 hours)
Intermediate	<ul style="list-style-type: none"> • Diabetes mellitus • Renal insufficiency (eGFR < 60mL/min/1.73m²) • Left ventricular ejection fraction ≤ 40% • Prior revascularisation; PCI or CABG • GRACE score between 109-140 	Routine angiography / revascularisation (within 72 hours)
Low	<ul style="list-style-type: none"> • No recurrent symptoms • No risk criteria 	Provocative testing & selective invasive strategy

Diagnosing a STEMI as soon as possible is vital, as reperfusion therapies must be given promptly to reduce morbidity and mortality. In the setting of a suggestive history, ECGs may need to be repeated at 10-15 minute intervals to diagnose an **evolving STEMI**.

Pre-flight and In-flight Management

1. During the pre-flight assessment establish an accurate diagnosis.
 - View the 12 lead ECG yourself (faxed or scanned and emailed).
 - Provide assistance with making the diagnosis and instituting management. (It is expected that the assessing doctor takes responsibility for guiding management where the referring practitioner is uncertain).
 - Understand the plan for this patient and the rationale behind it. (Does this patient really need an urgent procedure or is the issue more one of convenience? Are they holding the catheter lab open for this patient, or not intending to do anything until tomorrow?).
2. Pharmacological treatment.
 - Aspirin loading dose 300mg orally, (Medical Chest Item 62).
 - Glyceryl trinitrate (GTN) spray sublingual, titrated to pain and blood pressure (Medical Chest Item 190), may need patch or infusion. For symptom relief, response to GTN is not helpful for diagnostic purposes.
 - Morphine titrated IV (2mg aliquots) or if unable to gain IV access then IM 5-10mg. (Medical Chest Item 188). For symptom relief.

- Supplemental O₂ only if S_aO₂ <93% (COPD patients target S_aO₂ 88-92%) or signs of heart failure or shock.
- Anti platelet therapy
 - Clopidogrel 300mg loading dose if thrombolysis planned, 600mg if PCI planned and patient <75yrs; OR
 - Ticagrelor 180mg loading dose, 90mg bd. For moderate to high risk NSTEMI treated conservatively or invasively, and STEMI planned for primary PCI; OR
 - Prasugrel 60mg - may be used in place of clopidogrel in patients with STEMI of less than 12 hours where PCI is planned, or NSTEMI after angiography and before PCI.
- Anticoagulants
 - Unfractionated heparin and Enoxaparin: NSTEMI – Heparin infusion (5000 units loading dose followed by 1000 units per hour) or enoxaparin loading dose 1mg per kg SC. Use heparin if PCI planned that day. STEMI post fibrinolysis use either heparin infusion or enoxaparin. Do not switch between agents due increased risk of bleeding.
 - Glycoprotein IIb/IIIa inhibitors (Tirofiban). Routine use pre hospital or ED is of questionable value. May be used in selected high-risk NSTEMI patients in whom PCI is planned. Should be avoided after thrombolysis and should only be given with cardiologist advice (not widely available).
 - Bivalirudin 0.75mg/kg then 1.75mg/kg/hr may be considered as an alternative to glycoprotein IIb/IIIa inhibition and heparin in patients undergoing PCI with increased bleeding risk.
- β-blocker for severe hypertension or tachycardia if no contraindications: atenolol 2.5mg-10mg IV OR 25-100mg orally. Alternatively metoprolol 5mg-15mg IV OR 25-100mg orally. Titrate to HR of 55-60bpm.
- Correct electrolyte abnormalities that may predispose to arrhythmia (K⁺ and Mg²⁺)
- Maintain glycaemic control.
- Consider a statin and an angiotensin converting enzyme inhibitor (ACEI).

3. Reperfusion therapy.

- STEMI should be diagnosed early and reperfusion commenced as soon as possible provided no contraindications, for patients presenting within 12 hours of symptom onset and in the absence of advanced age, frailty, and comorbidities influencing overall survival.
- In practice no patients outside the metropolitan area are able to access primary PCI in an appropriate time frame leaving fibrinolysis the treatment of choice. Exceptions might exist for Rottnest Island and some inner rural locations where activation of an RFDS/SJA team on the DFES helicopter may be possible for a direct door to door transfer. The clinical coordinator in the RFDS Coordination Centre is best placed to judge the feasibility of this. Primary PCI is the treatment of choice when it can be done within 90 minutes of first medical contact.
- Timeframes for fibrinolysis:
 - Consider pre-hospital fibrinolysis by RN/paramedic/Doctor if time to hospital > 30 minutes.
 - Greatest efficacy if given within 3 hours of onset of symptoms.

- If symptom onset 3-12 hours ago urgent PCI within 2 hours has better outcome if logistically possible.
- Second generation fibrinolytics (tenecteplase or reteplase) are the agents of choice.
- Verbal consent should be obtained from patients and this recorded.

Table 2.2 Tenecteplase Dosage

Patient weight (kg)	Tenecteplase (IU)	Tenecteplase (mg)	Volume of reconstituted solution (mL)
<60	6,000	30	6
60 to <70	7,000	35	7
70 to <80	8,000	40	8
80 to <90	9,000	45	9
>90	10,000	50	10

Reteplase is given as 10 units intravenously, followed by 10 units after 30 minutes.

Table 2.3 Contraindications to thrombolysis

Absolute Contraindications	Relative Contraindications
<ul style="list-style-type: none"> • Haemorrhagic stroke or stroke of unknown origin at any time • Ischaemic stroke in the preceding 6 months • CNS damage, neoplasms, or structural vascular lesions (e.g. AVM) • Recent major trauma/surgery/head injury (within last 3 weeks) • Gastrointestinal bleeding with in last month • Known bleeding disorder (excluding menses) • Aortic dissection 	<ul style="list-style-type: none"> • TIA in preceding 6 months • Dementia • Oral anticoagulant therapy • Pregnancy or within 1 week post-partum • Non – compressible punctures • Traumatic resuscitation • Refractory hypertension (SBP > 180) • Advanced liver disease • Infective endocarditis • Active peptic ulcer

Failure to reperfuse

Successful reperfusion is suggested by:

- Patient is pain free
- Haemodynamically stable
- Cessation of arrhythmias
- Reduction of $\geq 50\%$ of maximum ST elevation by 60-90 minutes. Failure to reperfuse should result in a priority1 *transfer for rescue* angioplasty. (See Disposition).

4. Crew Mix

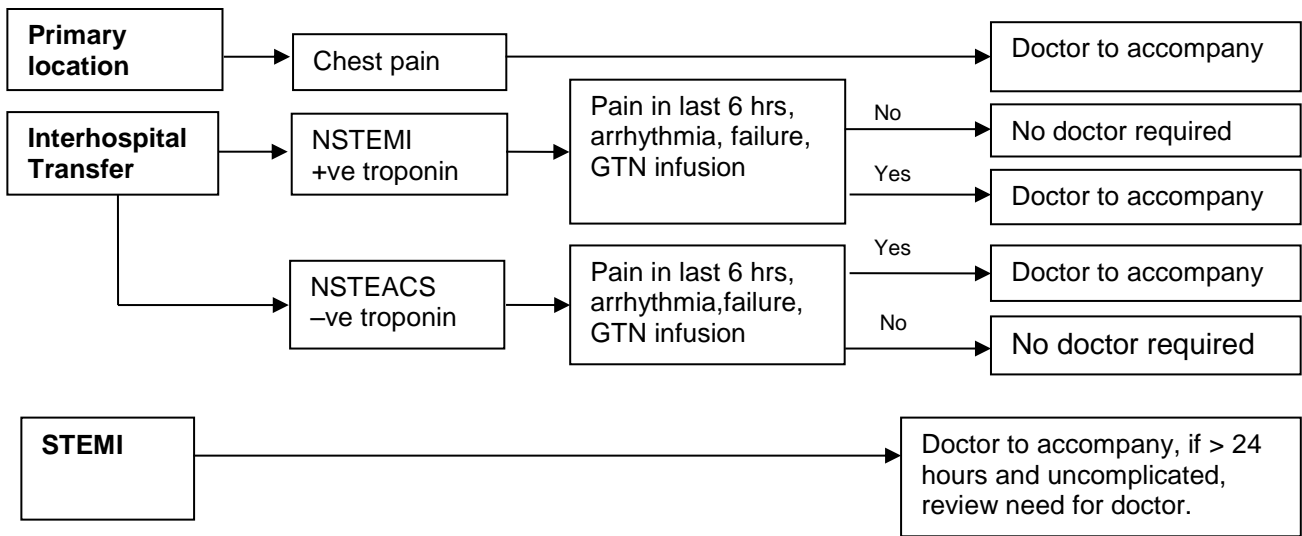
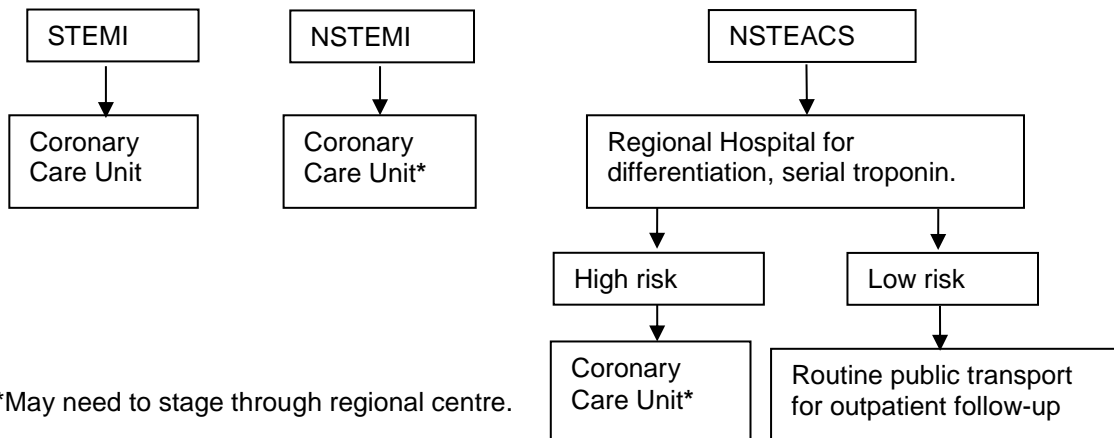


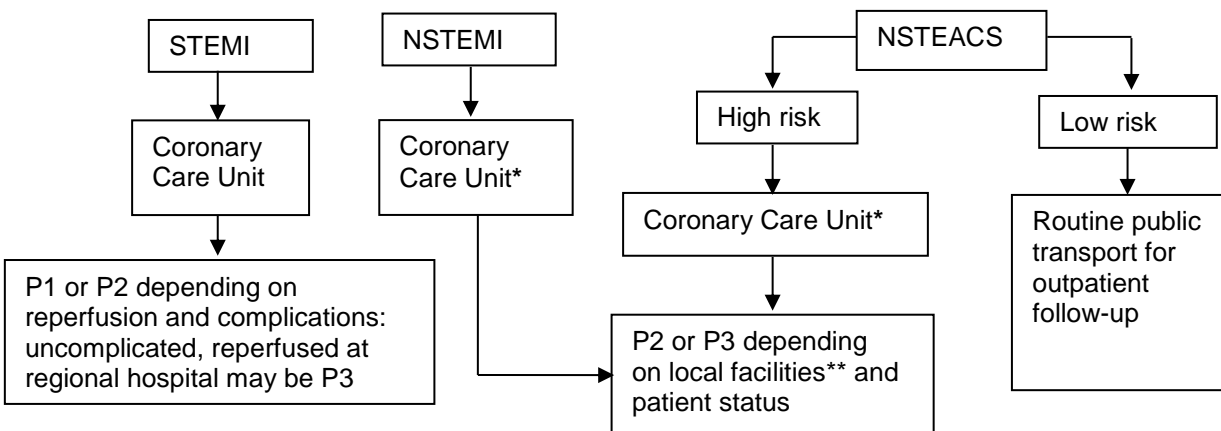
Figure 2.1. Crew Mix

5. Disposition and prioritisation

a) Chest pain in a *primary* location or hospital without doctor, tasked as P1 doctor accompanied



b) *Inter-hospital* transport of ACS



*May need to stage through regional centre
 **Regional centre with HDU P3 often appropriate

Figure 2.2. Disposition and Prioritisation

6. Ongoing management and communications
 - Patients should receive ongoing monitoring, before and during transport, with access to early defibrillation.
 - Provide oxygen to symptomatic patients and to correct altitude hypoxia.
 - Aim to achieve a pain free status inpatient (i.e. Remove any ongoing ischaemia).
 - Escalation in pain should result in repeat 12 lead ECG, some patients may require in-flight thrombolysis if a STEMI is evolving.
 - Patients requiring immediate access to PCI should have their arrival times communicated to receiving hospitals to ensure the appropriate reception. Priority 1 ambulances may occasionally be required for these patients, operations staff need to be made aware of this requirement.
7. When RFDS stock of tenecteplase is used, the flight doctor must write a replacement script on a standard prescription form including the correct patient name and Medicare number. This must be provided to the flight nurse at the end of the flight. This is **vital** to maintain supply.

Medical Chest Items

GTN spray (Item 190), Aspirin 300mg tabs (Item 62), Morphine 10mg amps (Item 188)

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2.2 Acute Pulmonary Oedema

Theory

Respiratory failure due to acute pulmonary oedema (APO) will be exacerbated by altitude hypoxia so supplemental oxygen is mandatory.

Pre-flight and In-flight Management

Flights are usually either priority 1 or 2, doctor accompanied, depending on the facilities at the referring location.

1. Diagnose and treat precipitating causes, including myocardial infarction, cardiac arrhythmias, pericardial effusion, hypertrophic cardiomyopathy and valvular heart disease.
2. Consider non-cardiogenic pulmonary oedema. Eg, ARDS, neurogenic, pulmonary embolism, pre-eclampsia, transfusion related lung injury (TRALI) and opioid overdose.
3. Administer high flow oxygen with the patient sitting upright. Maximal supplemental oxygen followed by assisted ventilation should be used before resorting to a sea level cabin.
4. Give nitrates, either sublingually, or by infusion (commence at 10µg/min) (See Infusion Guideline). Maintain a systolic blood pressure \geq 90mmHg. Topical application may not be reliable if sweaty or clammy.
5. Beware of reducing pre-load where there is aortic stenosis. Seek specialist advice early due to risk of cardiovascular collapse. Dobutamine may be useful in this circumstance.
6. Give IV frusemide 20mg - 80mg IV, repeating at 20 minutely intervals as necessary. Higher doses may be required if patient is taking frusemide regularly.
7. Note: A urinary catheter is essential to monitor output hourly.
8. If hypotensive, consider inotropic support (may then add vasodilator once in situ).
9. Consider the need for digoxin, especially if in atrial fibrillation.
10. If condition worsening consider NIV (Non Invasive Ventilation) or ventilation with \geq 5mmHg of PEEP and high dose oxygen. (See [Non-Invasive Ventilation](#)).
11. Other less commonly used treatment modalities include venesection of 500mL of blood (beware risk of hypovolaemia) or rotating tourniquets.
12. In poorly compliant dialysis patients who are overloaded, inducing diarrhoea with sorbitol / lactulose is sometimes used in an inpatient setting but not appropriate in the retrieval environment.

Special Notes

1. Intubation should be considered for all patients in APO who require high flow O₂ at rest at the referring location. Especially look for confusion, exhaustion, a rising PCO₂ and or relatively low PO₂.
2. NIV may avoid the need for intubation but its use in the transport setting can be difficult (See [Non-Invasive Ventilation](#)).
3. Avoid nitrates in patients who have received sildenafil (Viagra) in the previous 24 hours.
4. Morphine has been shown to adversely affect outcome in some studies and should be only be used judiciously.

Medical Chest Items

Frusemide tabs 40mg (Item 85), Sublingual GTN spray (Item 190), Aspirin 300mg tabs (Item 62).

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2.3 Cardiac Arrhythmias

Theory

1. Cardiac arrhythmias are common and do not always require treatment in flight.
2. Diagnosis should be based on a 12 lead ECG where possible.
3. Priorities are always AIRWAY, BREATHING and CIRCULATION with application of supplemental oxygen and establishment of IV access. Patients should be fully monitored. If the patient is PULSELESS manage immediately according to the ALS algorithm. [See [Basic Life Support Flow Chart](#), [Newborn Life Support Flow Chart](#), [Advanced Life Support \(Adult\)](#), [Advanced Life Support \(Paediatric\)](#)].
4. Determine if the patient is STABLE or UNSTABLE. Unstable patients and patients with “stable VT” require immediate management. Features of instability are as follows:
 - a) Hypotension
 - b) Chest pain
 - c) Pulmonary oedema
 - d) Altered conscious state
 - e) Bradycardia <40 bpm , Tachycardia > 150 bpm
5. All antiarrhythmics have the potential to exacerbate dysrhythmias and cause myocardial depression.

Pre-flight and In-flight Management

1. During pre-flight assessment type of arrhythmia and stability should be established. A copy of the 12-lead ECG should be obtained. Advice regarding immediate management should be given including resuscitation, drugs and cardioversion.
2. Prioritisation will depend on skills and resources available at the referring location.
3. Unstable patients and those with a significant precipitating event (e.g. Acute coronary syndrome) and co-morbidities likely to result in an in-flight deterioration should be doctor accompanied.
4. All patients should have oxygen, venous access and be fully monitored.
5. Management is reliant on recognition of specific arrhythmias.
6. Sinus bradycardia and tachycardias require treatment of the underlying cause (e.g. hypovolaemia, fever, pain, left ventricular failure (LVF)) rather than specific antiarrhythmics or cardioversion.
7. For digoxin toxicity Digibind® may be required. Access at regional hospital or transport patient to regional hospital.

Bradycardias

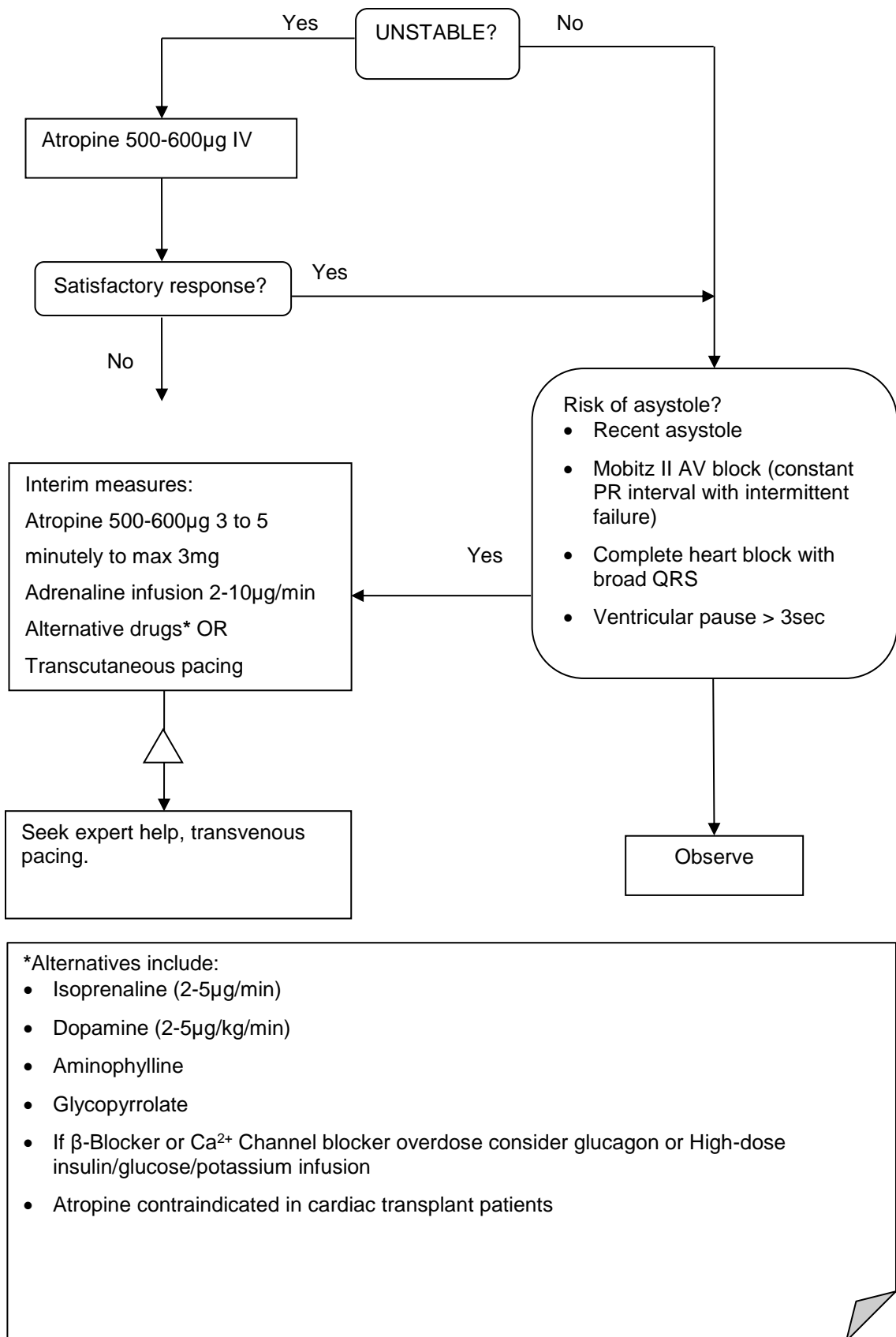


Figure 2.3. Bradycardias

Tachycardias (with a pulse)

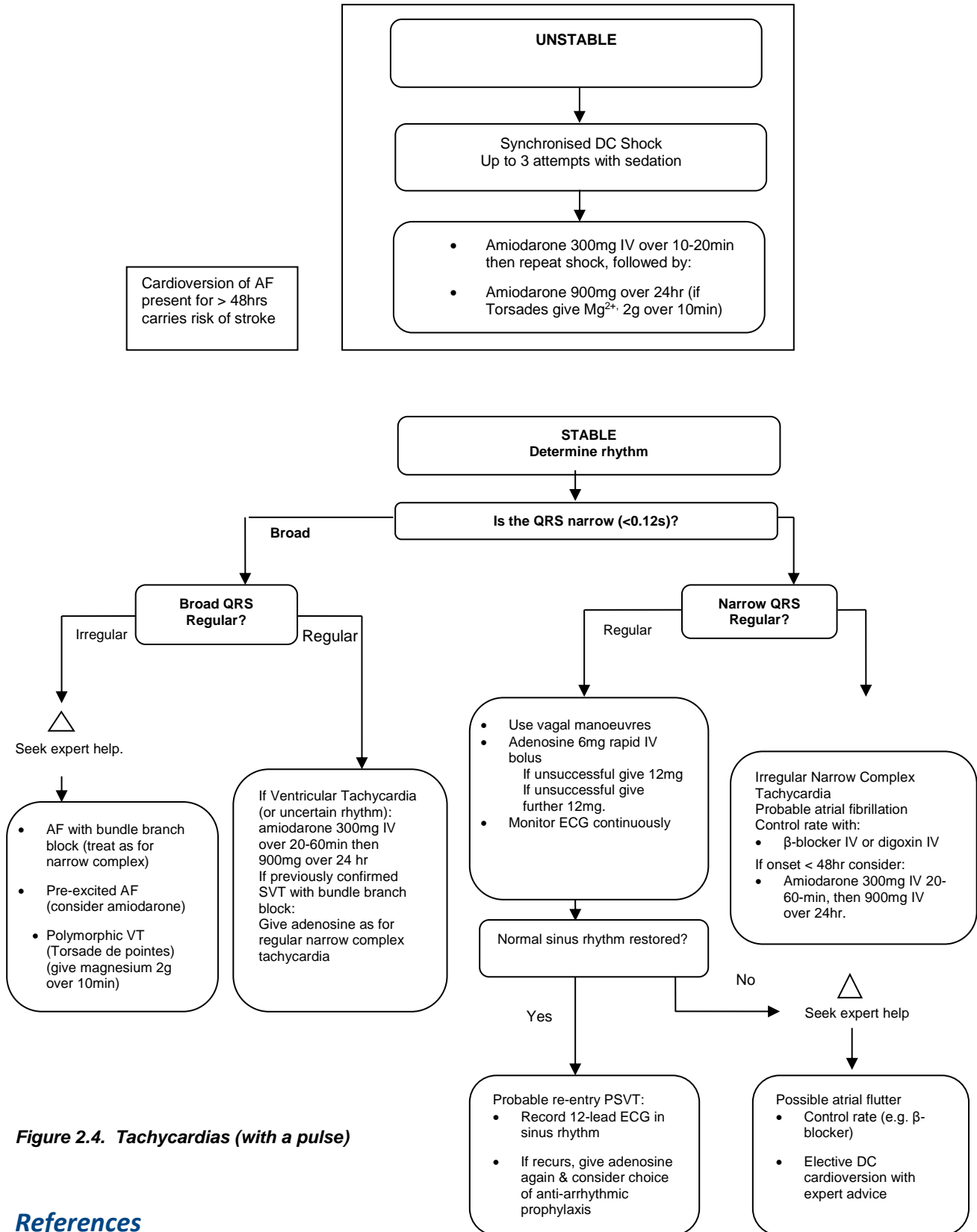


Figure 2.4. Tachycardias (with a pulse)

References

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3 ENDOCRINE

3.1 Diabetic Ketoacidosis

Theory

1. Diabetic ketoacidosis (DKA) is a state of relative or absolute deficiency of insulin, resulting in hyperglycaemia, ketosis, high anion gap metabolic acidosis and dehydration. The hyperglycaemia causes glycosuria, osmotic diuresis and progressive loss of fluid and electrolytes. The biochemical criteria are, venous pH <7.3 **or** bicarbonate <15mmol/L **plus** blood or urinary ketones.
2. In a fully evolved hyperglycaemic coma, the most important clinical features are deep rapid breathing (Kussmaul respirations, secondary to acidosis), severe dehydration, circulatory insufficiency (hypotension, tachycardia) muscular weakness and a depressed level of consciousness.
3. Average deficits in diabetic ketoacidosis are 5-7 litres of water, 300-450mmol of sodium and 3-5mmol/kg of potassium. Correction of hyperglycaemia (4-8 hours) is more rapid than correction of acidosis (10-20 hours). The principle of treatment is to give dextrose and insulin until acidosis is corrected and ketones cleared.
4. Underlying causes include; infection, newly diagnosed insulin dependent diabetes mellitus (IDDM), insufficient insulin (compliance, pump failure), infarction (myocardial, cerebral, gastrointestinal, peripheral vascular), intercurrent illness (e.g. diarrhoea and vomiting).

Pre-flight and In-flight Management

1. Pre-flight and in-flight management will be aimed at replacing fluid and electrolyte losses, correcting the ketosis and hyperglycaemia as well as commencing treatment for any underlying cause.
2. Flights are usually Priority 1 or 2, doctor accompanied, depending on the facilities at the referring location.
3. Ensure a secure airway, administer oxygen therapy and establish IV access.
4. Monitor GCS and vital signs frequently, BSL and urine output hourly (aim for >0.5mL/kg/hr) and consider NGT insertion. Blood gas, venous may be sufficient (pH, K⁺ and bicarb) *monitoring 2 hourly* for initial 6 hours.
5. Aim for 3-5mmol/hr fall in BSL, 3mmol/hr rise in bicarbonate, maintain potassium in normal range. Avoid too rapid a fall in BSL.
6. IV fluids:
 - a) Normal saline 500mL (10mL/kg for children) bolus over 10-15 mins if shocked or SBP <90mmHg systolic, with dose repeated if required. If contemplating a third bolus in children seek advice, rarely required and potential for harm.
 - b) Subsequently or if SBP >90mmHg systolic use normal saline 1L in first hour, then
 - c) Normal saline (with 20-40mmol KCl when K⁺ <5.5mmol/L) x 2L over 4 hours, then
 - d) Normal saline (with KCl) 2L over 8 hours, then
 - e) Normal saline (with KCl) 1L over 6 hours,
 - f) Further litres dependent on vital signs, clinical hydration state and CVP. Once euvolaemic 0.45% saline may be used if hypernatraemia is present.
 - g) Add 10% dextrose when BSL < 14mmol/L at 125mL/hr. Normal saline may be given concurrently if still correcting volume. (Children: requirements dependent on degree of dehydration. Aim to give deficit [% dehydration x body weight] + maintenance over

48 hours). Assume dehydration not > 5% and give normal (0.9%) saline with 5% dextrose. If BSL falling too rapidly give 7.5% dextrose (add 75mL of 50% dextrose to 425mL normal (0.9%) saline).

7. Insulin infusion:

- In adults give actrapid (50 units in 50mL normal (0.9%) saline) at 5 IU/hr IV (if not falling adequately in first 2 hours double rate), continue the patient's usual long acting insulin if prescribed.
- In children with pH > 7.2 use subcutaneous regime. Give actrapid 0.1 IU/kg SC then follow with 0.1 IU/kg SC every 2 hours until acidosis is corrected.
- In children with pH < 7.2 use intravenous infusion (50units actrapid in 50mL normal (0.9%) saline) 0.1IU/kg/hr.

Note: Flush IV tubing with 20mL of solution as insulin binds to the plastic.

8. If laboratory facilities available check electrolytes, glucose and blood culture; also request urea, creatinine, osmolarity, blood gases, urine and blood ketones, 12-lead ECG, to look for signs of hyper- or hypokalaemia and acute myocardial ischaemia.
9. Potassium level may be high initially despite depleted stores. Take care with administration if the serum level is not known and do not commence potassium replacement in the presence of oliguria or if serum K⁺ is > 5.5mmol. Replace K⁺ at 40mmol/hr if K⁺ < 3.5mmol.

Special Notes

The endocrinology team at PMH prefer to be involved in management decisions for paediatric patients early.

Cerebral oedema can occur suddenly and is more common under 20years. Mortality is high. Signs include; headache, lethargy and irritability followed by depression consciousness, bradycardia, hypertension and respiratory impairment. Treat with 20% mannitol IV 0.5-1g/kg (2.5-5mLs/kg) over 20 mins or 3% *hypertonic* saline (3mL/kg) slow push and reduce fluid rate by one third, and nurse head up.

References

1. Princess Margaret Hospital for Children. Clinical Practice Manual 2016. Available from: www.kidshealthwa.com. PMH DKA emergency management pathway. PMH ED DKA Fluid Calculator.
2. Endocrinology drug guidelines. In: eTG complete : Therapeutic Guidelines Limited; 2017

3.2 Hypoglycaemia

Theory

1. Hypoglycaemia needs to be considered as a differential diagnosis in all unconscious patients (especially but not exclusively diabetic patients), in all patients with abnormal behaviour and in all patients with unexplained neurological signs.
2. Moderate hypoglycaemia is characterised by tachycardia, sweating, clamminess, paraesthesia (face and hands), irritability, hunger and agitation.
3. Severe hypoglycaemia is characterised by mental confusion, bizarre behaviour, seizures, hypothermia and coma (hydrated, quiet and flaccid).
4. All symptoms may be blunted by alcohol, sedatives, patients on β -blockers and in the elderly.
5. The most common cause of hypoglycaemia is overdose of insulin or oral hypoglycaemics, particularly long acting sulphonylureas such as gliclazide. Other causes include inadequate food intake, reactive (post-prandial), drugs (salicylates, iron, alcohol), status epilepticus and counter-regulatory (Addison's disease, hypopituitarism, myxoedema, severe cachexia, hepatic failure or severe renal failure).

Table 3.1. Hypoglycaemia – Normal Reference Range by Age

Age	Normal Reference Range
0-6 months	2.2-5.0mmol/L
7 - 12months	1.9-8.0 mmol/L
2 years	2.8-7.2mmol/L
3 years	3.3-6.7 mmol/L
adults(fasting)	3.6-5.8 mmol/L

Note: Hypoglycaemic symptoms and signs may occur at almost normal levels if a patient is accustomed to high blood sugar levels.

Pre-flight and In-flight Management

Monitor BSL hourly

1. If conscious:
 - Oral barley sugar, sweetened orange juice or sandwiches.
 - If cause was a long-acting insulin (NPH or Lente), an IV infusion of 10% dextrose 50-125mL/hr will need to be run for 24 hours and the patient will need to be admitted for observation.
 - If cause sulphonylurea commence octreotide; bolus 1 μ g/kg (max 50 μ g) IV followed by 1 μ g/kg/hr (max 25 μ g/hr). Bolus dextrose as required.
2. If unconscious:
 - Resuscitation as for all unconscious patients, with attention to airway, breathing and circulation.
 - Establish IV access and give 50mL of 50% dextrose in water at 10mL/min, preferably into a proximal vein.
 - May cause hypokalaemia if given too quickly.
 - Most patients recover in 5-10 mins unless hypoglycaemia was prolonged.

- If chronic alcohol consumption is suspected, give 100mg thiamine IM or IV before dextrose to prevent Wernicke's encephalopathy.
- Treat fitting with diazepam 0.2mg/kg IV, repeated as needed or PR diazepam 0.5 mg/kg

Special Notes

1. Children:
 - Give 20mL of 5% dextrose orally or NGT or 2mL/kg of 10% dextrose IV. Use of 50% dextrose has been associated with deaths due to hyperosmolality.
2. Glucagon:
 - 1mg IM or SC or IV, 0.03mg/kg IM for children to a maximum dose of 1mg.
 - Side effects include nausea and vomiting, initially hyperkalaemia, then hypokalaemia.

References

1. Endocrinology drug guidelines in: eTG complete. Melbourne: Therapeutic Guidelines Limited; 2017.
2. Murray L, Daly F, Little M, Cadogan M. Toxicology Handbook. 3rd ed.: Elsevier; 2015.
3. Princess Margaret Hospital for Children. Clinical Practice Manual 2016. Available from: <http://kidshealthwa.com/guidelines/hypoglycaemia/>

3.3 Hypocalcaemia

Theory

1. This is a relatively common condition and, though rarely life-threatening, it needs to be recognised and treated appropriately if potentially serious problems are to be prevented.
2. Serum calcium is composed of 3 fractions, 40% of the total serum calcium is bound to plasma proteins, chiefly albumin, 45% exists as ionised Ca^{2+} and 15% is bound to multiple organic and inorganic anions such as sulphate, phosphate, lactate and citrate.

Changes in the ionised fraction result in the signs and symptoms of hypo- and hypercalcaemia.

Acidosis *increases* the ionised fraction by displacing calcium from albumin whereas alkalosis *decreases* the ionised fraction; rapid changes in plasma acid-base status can therefore result in symptomatic hypocalcaemia. An example is that of an alkalosis of hyperventilation resulting in tetany. Hypocalcaemia can also result from massive transfusion of citrated blood (citrate binds to ionised calcium – resulting in hypocalcaemia).

Symptoms of Hypocalcaemia

Mild cases of hypocalcaemia presents with peripheral and peri-oral paraesthesia and severe cases with tetany, carpo-pedal spasm, hyperreflexia, colicky abdominal pain, stridor due to laryngospasm and life threatening convulsions.

Most infants with hypocalcemia are asymptomatic. If symptomatic, neuromuscular irritability is the most common sign, with jitteriness and muscle jerking. Less common findings include seizures and, rarely, laryngospasm, wheezing, or vomiting.

Signs of Hypocalcaemia

1. These include Chvostek's sign (spasm of the ipsilateral facial muscles when the facial nerve is tapped over the parotid gland), Trousseau's sign (carpo-pedal spasm caused by the reduction of the blood supply to the hand when a BP cuff above systolic pressure is applied to the forearm for 3 mins)
2. ECG changes which include lengthening of the QT interval and arrhythmias including Torsades.
3. Hypocalcaemia may be associated with hypomagnesaemia and hypokalaemia; this can be of significance in aboriginal children and is probably related to renal and gastrointestinal losses. Hypocalcaemia is difficult to correct unless magnesium deficit is corrected first.

Pre-flight and In-flight Management

1. The flight priority usually will depend on the underlying condition. If the patient is symptomatic and requiring active treatment then the flight will probably be Priority 2 and doctor accompanied unless treatment is not available locally then a priority 1 may be warranted.
2. Hypocalcaemia should always be considered in critically ill patients with sepsis, burns, acute renal failure, those who have been transfused with citrated blood, pancreatitis and those with hypoalbuminaemia.
3. Wherever possible blood electrolytes, including Ca^{2+} , Mg^{2+} , K^{+} and acid-base status should be known and all abnormalities corrected. The iStat analyser can provide valuable information and should be available in all cases where electrolyte and acid-base imbalances are present or are suspected. A 12-lead ECG should always be available as well. (Prolonged QT).
4. In mild cases with minimal symptoms and no tetany, oral replacement therapy is appropriate.

5. In more severe cases the treatment for adults is IV calcium gluconate 10% (20mL) or calcium chloride 10% solution (5-10mL). Give slowly in 50mL 5% dextrose over 10-20min. Monitor the Pulse rate, BP and ECG.
6. For Infants use IV calcium gluconate 10% (0.22mmol Ca²⁺/mL). Give 0.5-1mL/kg slowly over 10-20 mins. **Or** Calcium Chloride 10% 0.2mL/kg slowly over 10-20 mins. If bradycardia develops then the infusion should be ceased immediately.
7. NOTE: Calcium Chloride is metabolised more rapidly and may be more preferable if available.

Special Notes

1. Normal values (PathWest): Total calcium 2.25-2.60mmol/L; ionised calcium 1.12-1.32 mmol/L.
2. There are several case reports of patients receiving calcium for treatment of digoxin-induced hyperkalemia without adverse effects. In addition, a large retrospective series of patients with digoxin toxicity found no ill effects attributable to the administration of calcium. Nonetheless, because hyperkalemia is not the cause of death and excessive intracellular calcium is present in digitalis poisoning, we do **not** recommend routine administration of calcium in hyperkalemic patients with recognized digoxin toxicity. In this setting, hyperkalemia is best treated with digoxin-specific antibody fragments.

References

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4 GASTROINTESTINAL

4.1 Acute Pancreatitis

Theory

1. A multi-system disease due to inflammation of the pancreas. Commonest causes are gallstones (40- 70%) and alcohol (25- 35%). Other causes include, infection, trauma and medications. Overall mortality varies according to severity, from <1% overall with good intensive care support, to 30% with infected necrotic pancreatitis.
2. Diagnosis: At least 2 out of 3 of the following:
 - Acute upper abdominal pain
 - Amylase and/or lipase >3 times normal
 - Characteristic findings on CT, MRI, or U/S

Routine early CT scanning is not recommended if first 2 criteria positive.

3. Assessment of severity:
 - Mild: No organ failure or local or systemic complications. Usually self-limiting within a week. Consider delayed or no transport.
 - Moderately severe: Transient organ failure or complications of less than 48 hours
 - Severe: Organ failure of greater than 48 hours

Several scoring systems exist to *predict* severity largely based on physiological and laboratory abnormality (eg. <http://qihep.com/calculators/pancreatobiliary/bisap>). However they are of *limited use to RFDS* because of a low positive predictive value and need for 48 hours post-presentation for accurate scoring. Use *clinical judgment*, the main pointer to higher priority transfer is *signs of systemic involvement* (eg. Tachycardia/tachypnoea, Acute Respiratory Distress Syndrome, metabolic acidosis, Acute Tubular Necrosis, Disseminated Intravascular Coagulation, shock, ileus, pleural effusions, severe vomiting, haemorrhage, sepsis or necrosis of the pancreas). **NB. Most patients who develop severe pancreatitis have apparently mild disease on presentation**

Pre-flight and In-flight Management

1. Flights priority will vary according to severity, stage of illness and location.
2. Aggressive hydration (defined as 250-500mL/hr or higher as clinically indicated) with IV isotonic crystalloid solution is essential in the first 12- 24 hours (caution if cardiovascular and/or renal co-morbidity), together with frequent reassessment of fluid status. Doing so reduces the risk and extent of pancreatic necrosis and improves outcome. This is thought to be due to increased pancreatic perfusion.
3. Nasogastric tube is essential and the patient should remain “Nil By Mouth” until pain, nausea and vomiting have resolved. Prolonged fasting in mild cases is no longer recommended. Severe cases may require NG feeding to improve outcomes, ideally *after* 48 hours of fasting. Parenteral feeding (TPN) is to be avoided due to increased risk of infectious complications.
4. Urinary catheterisation is desirable in all but the mildest cases to assist with fluid management.
5. Treat shock according to standard procedure.
6. Ensure adequate analgesia with IV morphine or fentanyl, together with ondansetron for nausea

7. Measure acid/base and electrolytes during transfer and treat according to standard protocol.
8. Antibiotics are rarely indicated in the acute phase as sepsis occurs later in the illness. If clinically septic consult the accepting hospital regarding choice of antibiotic.
9. Apply ECG monitoring because non-specific ST-T wave changes and bradycardia due to toxins may be seen.
10. Intubation should be considered prior to transfer if evidence of ARDS is present and high flow rates of oxygen are required at rest in the hospital.
11. Severe cases may require direct referral to an Intensive Care Unit. There is evidence that management of severe pancreatitis in high-volume centres with daily access to interventional radiology, endoscopy and surgical services results in shorter length of stay and lower mortality rates.

References

1. Nesvaderani et al, Acute pancreatitis: Update on Management, Medical Journal of Australia 202 (8) · 2015
2. Scott Tenner et al, American College of Gastroenterology Guideline: Management of Acute Pancreatitis – 2013
3. Working Group IAP/APA Acute Pancreatitis Guidelines - 2013

4.2 Haematemesis and Melaena

Theory

1. Gastrointestinal tract (GIT) bleeding is a common medical emergency with significant morbidity and mortality. Despite treatment advances, 30 day mortality for patients presenting with upper gastrointestinal haemorrhage remains around 11%.
2. Haematemesis indicates bleeding proximal to the ligament of Treitz and occurs in only 50-66% of patients with upper GIT bleeding.
3. Melaena may mean haemorrhage from either the upper GIT or proximal colon.
4. Gastro-oesophageal varices account for 2-15% of all upper GIT bleeding. Bleeding will cease spontaneously in only 20-30% of cases but as bleeding is often more severe and recurrent, mortality approaches 25-40% for each episode of variceal haemorrhage.

Pre-flight and In-flight Management

1. Flights for patients will be usually priority 1 or 2. Flights where the patient has ongoing haemorrhage resulting in instability and/or requiring transfusion will be doctor accompanied.
2. Pre-flight management will include resuscitation of the patient and replacement of intravascular volume with isotonic crystalloid (normal saline or Hartmann's).
Blood should be given if there is persistent haemodynamic instability despite 2 litres of crystalloid, if the initial Hb <70 g/l, if there is significant re-bleeding, and in those patients with co-morbidities making them unable to tolerate periods of hypoperfusion or anaemia. Target >70g/l to 90g/l for patients with unstable IHD.
3. Oxygen should be administered to all patients.
4. Continuous ECG monitoring, non-invasive blood pressure monitoring and pulse oximetry should be instituted.
5. Patients should all have adequate IV access (two large bore cannulas 14 or 16g) Some patients may require inotropic support if still haemodynamically unstable despite adequate fluid therapy.
6. If possible blood (ideally cross matched type specific or if unable then uncrossed O neg) should be taken on the flight.
7. Terlipressin has largely replaced Octreotide in the management of variceal haemorrhage. Dose is 1.7mg IV bolus 6 hourly for 24 hours then 1.7mg IV 6 hourly for next 24hours. Terlipressin is contraindicated in pregnancy, peripheral vasoconstriction may also cause reduction in cardiac output by increasing afterload
8. Fresh frozen plasma should be given when the prothrombin time is 3 seconds greater than the control or when large transfusions are required. Platelet transfusion is rarely required unless platelet count is less than $50 \times 10^9 /L$. (See [Transfusion Medicine; Major Haemorrhage; Reversal of Anticoagulation](#)).
9. If bleeding from a gastric ulcer is suspected then IV proton pump inhibitor therapy should be considered. Esomeprazole or omeprazole or pantoprazole 80mg over 15 to 30 mins followed by infusion at 8mg/hour **or** pantoprazole 40mg IV bid to keep gastric pH >6 (See Drug Infusion Guideline 20. Pantoprazole.)

Special Notes

Balloon tamponade is not available to RFDS staff but occasionally patients from regional centres may have a Sengstaken-Blakemore tube or Minnesota tube in place, these patients are likely to be transported intubated. These tubes are NOT designed to be filled with water and must be filled with

4.3 Intestinal Obstruction

Theory

1. Intestinal obstruction may be caused by physical obstruction or absence of function (paralytic ileus).
2. Intestinal obstruction may occur in the small bowel or colon. Obstruction to the small bowel is acute; that of the colon, less so. Either may be partial or complete.
3. Patients with intestinal obstruction all have a quantity of gas trapped within the gut. Expansion of gas at altitude causes pain and may cause perforation of necrotic tissue. Patients with a complete intestinal obstruction, especially obstruction due to rigid external structures (e.g. hernia), are even more at risk.
4. Vomiting is common and changes in pressurisation can precipitate further vomiting with its attendant risk of aspiration.
5. Prolonged obstruction is complicated by perforation, sepsis and fluid/electrolyte disturbance. Patients should be resuscitated with appropriate fluids, K⁺ and antibiotics pre-flight.

Pre-flight and In-flight Management

1. The type and duration of the obstruction will determine the flight priority. Sicker patients, the very young and the very old may require a doctor accompanied flight.
2. All flights will require sea-level (or ground level) pressurisation. This, in most cases will preclude intermediary landings or 'meets' at airstrips whose elevation is considerably higher than sea-level.
 - The major changes in atmospheric pressure occur closest to the earth's surface in the first few thousand feet - if a patient is to become compromised it will occur there.
 - As in all things, however, occasionally a compromise is required if the risks (e.g. extra time taken to fly to Carnarvon rather than Meekatharra) outweigh the benefits. In some instances a patient with a bowel obstruction may suffer some additional pain on ascent to altitude but otherwise no serious adverse effects.
3. All patients will be 'nil by mouth', and will require IV fluids with close attention to be paid to hydration status. Patients who are vomiting or who have a small bowel obstruction require a nasogastric tube (NGT), which should be kept on straight drainage and aspirated at regular intervals. Sicker or elderly patients may require an indwelling catheter to allow more accurate monitoring of their urine output and fluid balance.
4. Where patients have been obstructed for some time, an up to date Na⁺, K⁺ levels and acid-base and lactate status can be provided by using the i-STAT analyser.
5. Analgesia should be provided with titrated IV narcotics. An anti-emetic is unnecessary and may be potentially harmful. Nausea and vomiting should be treated with NGT aspiration.

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5 GENITOURINARY

5.1 Acute/Chronic Kidney Injury

Theory

1. Acute renal failure is defined as a rapid increase in metabolic waste products (urea, creatinine, K⁺) usually associated with marked decrease in urine output. Isolated acute renal failure has a mortality of approximately 10%, in the setting of multi-organ failure the figure approaches 40-80%.
2. Features of acute renal failure include:
 - A rise in creatinine of > 100 µmol/1/day,
 - Oliguria (urine output less than 0.5mL/kg/hr)
 - Either fluid depletion or fluid overload
 - Altered mental state
 - Hyperkalemia
 - Metabolic acidosis (exacerbates hyperkalemia and causes hypotension and nausea). More rapid onset in catabolic states (sepsis, GIT bleed, rhabdomyolysis)
 - Uraemic symptoms - nausea, hiccoughs, drowsiness, flap, foetor, pericarditis, bruising/bleeding, itch, hypotension, coma,
 - Death due to arrhythmia (secondary to high K⁺), pulmonary oedema, GIT bleed, pericardial tamponade.

Pre-flight and In-flight Management

1. Priority and the need for a doctor will need to be determined on an individual basis. Most patients in acute renal failure will be tasked as priority 1 or 2, doctor accompanied.
2. Determine the cause:
 - a) Pre-renal:
 - Absolute hypovolaemia – bleeding, vomiting, diarrhoea, diuresis, burns, inadequate intake.
 - Relative hypovolaemia – vasodilatation (sepsis, vasodilators), reduced oncotic pressure (cirrhosis, nephrosis, sepsis, malnutrition),
 - Reduced cardiac output – pulmonary embolism, pericardial tamponade, infarct, arrhythmia.
 - Reno-vascular – renal artery thrombosis, atheroemboli.
 - b) Renal:
 - Glomerulonephritis, acute tubular necrosis, acute interstitial nephritis.
 - c) Vascular:
 - Malignant hypertension, haemolytic uraemic syndrome, severe pre-eclampsia.
 - d) Post - renal:
 - Pelvocalyceal - ureteric (solitary kidney, extrinsic (lymphoma), mural (stricture), luminal (stone, clot, sloughed papilla).
 - Vesicoureteric junction - bladder (Carcinoma of: bladder, cervix, bowel, stone).
 - Bladder neck - urethra (blocked catheter, stricture, prostate).

3. Determine type of renal failure and volume status:
 - a) Oliguric vs. non – oliguric?
 - Oliguric - <20mL/hr, 500mL/day. Oliguric has a higher mortality, treat early and monitor U&E, volume.
 - b) Patient 'wet' vs. 'dry'. Assess volume:
 - In chronic renal failure check weight daily as a marker of total body water (1kg =1 litre).
 - Low Na⁺ implies water overload not Na⁺ deficiency.
 - Extracellular fluid; oedema signifies > 2kg of fluid overload.
 - Reduced skin turgor if dry (beware elderly)
 - Intravascular volume;
 - i. JVP (aim for 2cm at 45°),
 - ii. BP (high if overloaded, postural drop present if dry)
 - iii. Capillary return; increased if dry.
4. Renal Support:
 - Maintain intravascular volume: aim for a MAP of 75-80mmHg by replacing fluids (monitor JVP / CVP), +/- inotropes
 - Remove nephrotoxins (eg. NSAIDs)
 - Monitor urine output
 - There is no evidence to support the use of “renal or low-dose dopamine”
 - Use of loop diuretics (frusemide) may reduce the need for dialysis
5. Manage complications:
 - Hyperkalemia
 - Pulmonary oedema

Special Notes

1. For Chronic Renal Failure patients on or nearing dialysis;
 - Avoid catheterization
 - Avoid IV cannulation or blood letting in forearm veins (may be required for fistula)
 - No BP measurements, cannulae or venepuncture on arm with fistula
2. Continuous ambulatory peritoneal dialysis (CADP) complications:
 - a) Overload:
 - Hypertension, increased weight, pulmonary oedema – Treat with more frequent bag changes (if getting more fluid back than instilled) or increase strength of glucose (max 2.5%)
 - b) Dehydration:
 - Treat by reducing glucose strength of bag
 - c) Peritonitis:
 - Pain, fever, diarrhoea, cloudy bag – Send whole bag for MC&S, give vancomycin 2g and gentamicin 0.6mg/kg (max 50mg) into bag daily until culture results. Give nystatin 500,000 units PO QID. Speak to renal physician.

- d) Exit site infection:
- Swab, then if Gram pos, vancomycin 1g intraperitoneal weekly for four weeks, or flucloxacillin 500mg 6 hourly for 2 weeks. If Gram neg, ciprofloxacin 500mg nocte orally for 3 weeks.

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6 INFECTIOUS DISEASES

6.1 Bacterial Meningitis

Theory

1. Acute Bacterial Meningitis is a life threatening emergency. The overall mortality is about 18% however this is raised at the extremes of age and in the immunocompromised.
2. The presentation may include a severe generalised headache more prominent over the occiput and worse with any manoeuvre that increases intracranial pressure. Other signs of meningeal irritation include photophobia and neck stiffness. Vomiting may be a prominent feature. Raised intracranial pressure may result in focal neurological signs, seizures, delirium and papilloedema.
 - Note: Lumbar punctures must not be performed where signs of raised intracranial pressure, focal neurological signs or a bleeding diathesis exist.
3. Patients with meningitis may be divided into two groups on the basis of presentation.
 - a) Acute presentation – Symptoms and signs have been present for less than 24 hours and are rapidly progressive. The causative organisms in these patients are usually pyogenic bacteria, and the mortality approaches 50%.
 - b) Subacute presentation – Symptoms and signs have been present for 1-7 days. Meningitis in this group of patients may be due to bacteria, viruses, or fungi, and the death rate in cases due to bacterial infection is much lower.

Pre-flight and In-flight Management

1. These flights would usually be doctor accompanied and priority 1 or 2.
2. Assess the airway. Patients may have an unprotected airway or hypoventilation from a depressed central nervous system and require intubation and ventilation.
3. Apply supplemental oxygen and monitor oxygenation (oximetry and ABGs).
4. Apply full cardiac monitoring. Note risk of bradycardia and other dysrhythmias with raised intracranial pressure.
5. Ensure IV access and normovolaemia. If hypovolaemic, resuscitate with normal saline. Check sodium, if low consider syndrome of inappropriate antidiuretic hormone (SIADH). (These patients may require fluid restriction to 2/3 maintenance).
6. Ensure normoglycaemia.
7. Attempt to gain blood cultures if possible but do not delay therapy if facility for this doesn't exist.
8. Administer empirical antimicrobial therapy based on age and likely pathogens.
 - a) Under 3 months of age: Gram negatives, *Group B streptococci*, *Staphylococci* and *Listeria*
 - amoxicillin 50mg/kg IV 6 hourly plus
 - cefotaxime 50mg/kg IV 6 hourly (ceftriaxone if unavailable)
 - b) Over 3 months of age: *Strep. pneumonia*, *Neisseria meningitides*, *Staphylococci*, (*Haemophilus influenzae* now uncommon since immunisation)
 - dexamethasone 10mg IV (0.15mg/kg IV) prior antibiotics then 6 hourly
 - cefotaxime 2g IV (50mg/kg IV) 6 hourly or ceftriaxone 2g IV (50mg/kg IV) 12 hourly

Plus

- vancomycin 1.5g slow IV infusion (30mg/kg slow IV infusion) 12 hourly **if** Gram positive diplococci or pneumococcal assay on CSF or concurrent otitis media, sinusitis, recent treatment with a β -lactam, or if viral or meningococcal infection unlikely.
 - i. Immunosuppressed and elderly: *Listeria*
 - Add benzylpenicillin 2.4g IV (60mg/kg IV) 4 hourly.
 - ii. Severe penicillin or cephalosporin allergy:
 - vancomycin 1.5g slow infusion IV (30mg/kg slow infusion IV) 12 hourly Plus
 - ciprofloxacin* 400mg IV (10mg/kg IV) 6 hourly
- Or**
- moxifloxacin* 400mg IV (10mg/kg IV) daily
- * Not carried by RFDS.

Special Notes

1. Treat seizures aggressively with anticonvulsants.
2. If *Neisseria meningitides* confirmed contacts will need antibiotic prophylaxis. This is a notifiable disease.
 - a) Only medical or nursing staff who have performed or attempted mouth to mouth resuscitation or intubation or are in prolonged close contact with the infected patient require prophylaxis.

Medical Chest Items

Ceftriaxone 2g powder for reconstitution (Item 402), water for injection 5mL (Item 168), phenoxymethylpenicillin powder for oral suspension 250mg/5mL (Item 401), phenoxymethylpenicillin tablets 500mg (Item 170), amoxicillin oral suspension 250mg/5mL (Item 130), amoxicillin capsules 500mg (Item 172), cephalexin oral suspension 250mg/5mL (Item 174), cephalexin capsules 500mg (Item 175).

References

1. Sanders C, Ho M. Current Emergency Diagnosis and Treatment 4th Ed. Appleton and Lange, 1992
2. Fauci A, Braunwald E, Kasper D, et al. Harrison's Principles of Medicine 14th Edition CD – ROM Version 1.2 McGraw Hill.
3. Watson C et al. Guidelines for control of meningococcal disease in Australia. NHMRC, AGPS 1996
4. McPhee S, Papadakis M, Tierney L. Current Medical Diagnosis and Treatment. 47th ed. Lange. 2007
5. Antibiotic drug guidelines [revised 2010 Jun]. In: eTG complete [CD-ROM]. Melbourne: Therapeutic Guidelines Limited; 2012 Jul.

6.2 Meningococcal Infection

Theory

1. *Neisseria meningitidis* is a gram negative diplococcus with many sero-groups, however 90% of disease is caused by sero-groups A, B or C. Transmission is via respiratory droplets. Up to 25% of the community are asymptomatic carriers. Risk factors include overcrowding, smoking, recent upper respiratory tract infection and complement deficiencies.
2. Meningococcal sepsis can occur with or without meningitis.
3. Features of systemic sepsis include:
 - Rapidly deteriorating (death can occur in under 2 hours) influenza like presentation with fever and myalgia.
 - Rash: Characteristic purpuric (although sometimes petechial) lesions on trunk and limbs that may coalesce to large ecchymoses.
 - Respiratory features: tachypnoea, hypoxia, pulmonary oedema and ARDS.
 - Cardiovascular collapse, distributive shock.
 - Neurological features: agitation, confusion, reduced level of consciousness.
 - Renal complications: Acute renal failure, metabolic acidosis
 - GIT: diarrhoea, vomiting
 - DIC
 - Septic arthritides

Pre-flight and In-flight Management

1. Most if not all flights for suspected meningococcal infection should be priority 1 doctor accompanied.
2. When suspected empirical therapy should commence immediately, do not wait for a definitive diagnosis, the patient is likely to be dead by then.
3. In a pre-hospital setting:
 - benzylpenicillin < 3yrs 300mg IV/IO or IM*
1-9yrs 600mg IV/IO or IM*
>9 yrs 1.2g IV/IO or IM*
 - * Preferably IV/IO as shock may prevent absorption via the intramuscular route.
4. In remote setting such as nursing post or if allergic to Penicillin:
 - ceftriaxone 2g (50mg/kg) 12 hourly or 4g daily
5. In hospital setting:
 - ceftriaxone 2g (50mg/kg) 12 hourly or cefotaxime 2g (50mg/kg) 6 hourly
 - If penicillin allergy; ciprofloxacin 400mg (10mg/kg) 12 hourly
6. Manage shock aggressively:
 - 2 x large bore peripheral cannulae or intra-osseous needle
 - Fluid boluses (note > than 30mL/kg pulmonary oedema is common)
 - Inotrope support very commonly required.

- Early goal directed treatment (See [Severe Sepsis](#)) aim for: CVP 8-12mmHg), MAP \geq 65mmHg, Urine output \geq 0.5mL/kg/hour. (Central venous $SO_2 \geq 70\%$, however this cannot be measure using our equipment). Adequate Hb.
7. Seek specialist advice regarding steroids, DVT prophylaxis, and GIT prophylaxis.
 8. Maintain normoglycaemia and keep electrolytes within normal limits.

Special Notes

This is a notifiable disease, confirmed contacts will need antibiotic prophylaxis, this can be arranged through public health. Prophylaxis will consist of either; ceftriaxone 250mg IM stat (if pregnant), or ciprofloxacin 500mg orally stat (adults), or rifampicin 600mg orally (adult) 5mg/kg (neonate) 10mg/kg child 12 hourly for 2 days.

Only medical or nursing staff who have performed or attempted mouth to mouth resuscitation or intubation / airway suction, or are in prolonged close contact with the infected patient require prophylaxis.

Medical Chest Items

Ceftriaxone 2g powder for reconstitution (Item 402), water for injection (Item 168), phenoxymethylpenicillin tabs 500mg (Item 170), phenoxymethylpenicillin powder for oral suspension 250mg/5mL (Item 401).

References

1. NHMRC. Guidelines for the control of meningococcal disease in Australia. Oct.1996.
2. Bersten A, Soni N. Oh's Intensive Care Manual. 6th ed. Butterworth Heinemann. 2009.
3. NHMRC. The Australian Immunisation Handbook. 8th Ed, 2008
4. Antibiotic drug guidelines [revised 2010 Jun]. In: eTG complete [CD-ROM]. Melbourne: Therapeutic Guidelines Limited; 2012 Jul.
5. Beed M, Sherman R, Mahajan R. Emergencies In Critical Care. Oxford: Oxford University Press 2007.

6.3 Tuberculosis

Theory

1. *Mycobacterium tuberculosis* is transmitted in airborne droplet nuclei by people with pulmonary or laryngeal tuberculosis during expiratory efforts, such as coughing or sneezing. Even casual close exposure to an infection case has been known to lead to infection in a contact.
2. As a general rule persons with sputum positive for acid fast bacilli (AFB) on microscopy are considered most infectious while patients with extra-pulmonary disease are not.
3. There is no evidence to suggest that the risk of transmission of tuberculosis (TB) on aircraft is greater than in any other confined space (Including other forms of public transport) if the duration of transfer is the same. Risk of transmission seems particularly to be related to prolonged transfers (duration of flight >8 hours).

Pre-flight and in-flight management

1. Isolation is **unnecessary** for patients with tuberculosis whose sputum is bacteriologically negative, who do not cough or who are known to be on adequate therapy (based on known or probable drug susceptibility and a clear clinical response to therapy).
2. If the patient has or is suspected to have active pulmonary disease **and** he/she has not been given adequate therapy, the following precautions should be observed:
 - Patient to wear a mask capable of filtering submicron particles and to use tissues to cover their mouth and nose when coughing or sneezing; the tissues should then be placed in a disposable plastic bag that can be sealed.
 - Staff and other patients to wear a mask capable of filtering submicron particles when with the patient in a confined space, e.g. inside the aircraft or road ambulance.
 - For pilots it is recommended that a mask be worn when transferring and handling patients but given; the unlikelihood of a flight longer than 6 hours, separation from patient, patient mask usage and difficulty with radio communications, a mask is not necessary in flight.
 - People in an immunocompromised condition or on immunosuppressive therapy should not be carried on the same aircraft.
3. In suspected cases all undiagnosed patients with cavitations in the upper lungs, or haemoptysis should be considered as infectious in the absence of sputum results.

Special Notes

1. RFDS currently stock masks capable of filtering submicron particles. The only drawback is that to be efficient they may make breathing difficult for a sick patient. For these patients a mask with a one-way valve so that the air is only filtered when breathed out may be more suitable.
2. For the very rare occasion of transferring a person with active multi-drug resistant TB, a full hood type of respirator fitted with HEPA filter will be required for the accompanying medical staff.
3. For further information contact the Perth Chest Clinic on (08) 9325 3922.
4. For aircraft airing and decontamination refer to RFDSWO infection control manual.

References

1. Chin J. Control of Communicable Diseases Manual. 17th ed. American Public Health Association. 2000.
2. Centers for Disease Control and Prevention, Atlanta. Exposure of Passengers and Flight Crew to Mycobacterium tuberculosis on Commercial Aircraft, 1992-1995. Morbidity and Mortality Weekly Review. March 03, 1995 / 44(08);137-140.
3. Centre for Disease Control, Atlanta. *Tuberculosis Risk on Aircraft*
http://www.cdc.gov/travel/tb_risk.html
4. Pang, Dr Shing. Perth Chest Clinic – personal communication, March 2000.

6.4 Melioidosis

Theory

1. Melioidosis results from infection with the soil and water bacterium *Burkholderia pseudomallei*, usually by transmission through bare feet, although inhalation of aerosolised bacteria can occur and transmission through contaminated water supplies. Most cases occur in the “Wet Season” and the endemic regions are South East Asia and Northern Australia. Although a rare disease, it has a significant incidence (100 cases/year) in East Kimberley and the Northern Territory.
2. Clinical presentation depends on mode of infection, infecting dose of bacteria and host risk factors. Diabetes is the most important risk factor, followed by excessive alcohol consumption, chronic renal disease and immune suppressive therapy. The usual incubation period is 1-21 days, although latency with subsequent reactivation does occur.

Clinical Presentation

Around half cases present with pneumonia, which can be part of a fatal septicaemia, a unilateral chest infection, or a chronic illness resembling TB. Severe cases often present as overwhelming sepsis with multiple organ abscesses. Prostatic abscess is common in males. Most of the cases we see come from remote Aboriginal communities in the Kununurra area.

Pre-flight and In-flight Management

1. A high index of suspicion will help to diagnose Melioidosis in susceptible individuals during the “Wet Season” (November – March). Suspected cases should be moved promptly to Darwin or Perth usually as P1 or 2 doctor accompanied flights.
2. Investigations should include, where possible:
 - a) Culture of blood, sputum, urine, skin lesions and abscesses. Throat and rectal swabs for culture in Ashdown’s media (should be available in Kimberley hospitals).
 - b) CXR.
 - c) CT abdomen and pelvis.
3. Manage according to “Severe Sepsis Guidelines” (See [Severe Sepsis](#)). Early antibiotic therapy, (do not wait for confirmation of diagnosis) with meropenem 1g IV (25mg/kg) 8 hourly. RFDS do not carry this routinely so it should be sourced from either local or regional hospital.
4. Advice regarding management is available from the Royal Darwin Hospital Infectious Diseases Team at RDH: (08) 8922 8888.

References

1. Currie BJ, Ward L, Cheng AC (2010) the Epidemiology and Clinical Spectrum of Melioidosis: 540 Cases from the 20 year Darwin Prospective Study. *PLoS Neglected Tropical Diseases* 4(11): e900.doi:10.1371/journal.pntd.0000900
2. Cheng AC, Currie BJ. Melioidosis: epidemiology, pathophysiology, and management. *Clin Microbiol Rev* 2005; 18(2):383-416

6.5 Severe Sepsis

Theory

1. Sepsis is defined as the dysregulated systemic response to an infection, manifested by organ dysfunction from hypoperfusion or hypotension.
 - Clinical features of sepsis are non specific, and can include;
 - symptoms and signs specific to an infectious source (eg, cough dyspnea may suggest pneumonia, pain and purulent exudate in a surgical wound may suggest an underlying abscess).
 - Arterial hypotension (eg, systolic blood pressure [SBP] <90mmHg, mean arterial pressure [MAP] <70mmHg, an SBP decrease >40mmHg, or less than two standard deviations below normal for age).
 - Temperature >38.3°C or <36°C.
 - Heart rate >90 beats/min or more than two standard deviations above the normal value for age.
 - Tachypnoea, respiratory rate >20 breaths/min or P_aCO₂ <32 mmHg.
 - Altered mental status.
 - Ileus (absent bowel sounds; often an end-stage sign of hypoperfusion).
 - Decreased capillary refill, cyanosis, or mottling (may indicate shock).
 - All of these signs can be masked in neonates.
2. Septic shock is defined as a subset of sepsis complicated by hypotension that does not respond to intravenous fluid resuscitation (30mL/kg), and requires vasopressor support to maintain a MAP >65mmHg, with a lactate >2mmol/L.
3. The **quick Sequential (sepsis-related) Organ Failure Assessment (qSOFA)** score is a tool to help identify patients with early sepsis outside of the ICU. One point is assigned for each for the following clinical features:
 - Respiratory rate ≥22/min.
 - GCS <15.
 - Systolic blood pressure ≤100mmHg.

Patients with **two or more** of these features were reported to have poor outcomes and higher mortality from sepsis.

Pre-flight and in-flight management

1. Priority and need for doctor is to be assessed on an individual basis and depends on resources at referring location. Most patients with sepsis would be priority 1 or 2 and doctor accompanied.
2. Patients with sepsis need **urgent empirical antibiotic** treatment and **urgent resuscitation** to provide optimal organ perfusion and oxygenation.
3. Initial management of a suspected sepsis or septic shock:
 - Administer oxygen. Consider HFNC, CPAP/BiPAP. Intubation and ventilation may be necessary to maintain adequate gas exchange in altered conscious state. Use protective lung ventilation (VT 6mL/kg PBW, P_{plat} <30 cm H₂O) Titrate to S_pO₂ >94%.

- Establish IV/IO access, and if possible two sets of blood cultures and other appropriate cultures are recommended, but should not delay giving empirical antibiotics.
- Administer appropriate empirical antibiotics ideally **within the first hour**.
- Administer IV fluid challenges of 500mL-1000mL Crystalloid (child 10-20mL/kg) if the patient is hypotensive or if there are other signs of organ hypoperfusion such as oliguria, elevated lactate, or altered conscious state.
- ***If hypotension does not respond to IV fluid resuscitation (following 2L IV crystalloid /20-30 mL/kg) commence vasopressor infusion*** (usually Noradrenaline, preferably via a central line or 18G in antecubital fossa or humeral head IO).
- Aim for a SBP>90mmHg or MAP > 65mmHg but remember that many of our patients require a higher MAP for adequate organ perfusion.
- Aim for urine output of over 0.5mL-1mL/kg/hour, improving mental status, lactate <2mmol/L or reduced by 10% over 2 hours.
- Consider packed cell transfusion if Hb <7.0g/dl.
- The use of corticosteroids (hydrocortisone 200mg IV daily) remains controversial but may be indicated in patients unresponsive to fluid challenges and vasopressors. Discuss with accepting ICU.
- Maintain adequate glycaemic control. BSL 6-10mmol/L.

Empirical antibiotic treatment, no obvious source:

1. Adult: flucloxacillin 2g 4 hourly PLUS gentamicin 7mg/kg (ideal body wt) IV one dose, then adjust subsequent dose for renal function.
2. Adult hypersensitive to penicillin: vancomycin 30mg/kg up to 1.5g 12 hourly PLUS gentamicin 7mg/kg IV one dose.
3. Adult in area of high prevalence MRSA, or known MRSA carrier: vancomycin 30mg/kg up to 1.5g 12 hourly PLUS gentamicin 7mg/kg IV one dose.
4. Child under 2 months: cefotaxime 50mg/kg IV 6 hourly PLUS amoxy/ampicillin 50mg/kg IV 6 hourly.
5. If herpes simplex encephalitis is suspected in neonates in whom meningitis has not been excluded, add acyclovir 20mg/kg IV.
6. Child over 2 months: cefotaxime 50mg/kg up to 2 g IV 6 hourly OR ceftriaxone 50mg/kg up to 2g 12 hourly. If critically ill ADD gentamicin 7.5mg/kg IV, for the first dose PLUS vancomycin 30mg/kg up to 1.5g IV 12 hourly.
7. If meningitis is suspected see [Bacterial Meningitis](#). If meningococcaemia is suspected see [Meningococcal Infection](#).
8. Neutropenic (neutrophils less than $0.5 \times 10^9/L$), and immunosuppressed patients: ceftazidime 2g (child 50mg/kg) 8 hourly or OR piperacillin + tazobactam 4g+0.5g (child 100mg+12.5mg/kg up to 4g+0.5g) IV 8 hourly OR cefepime 2g (child 50mg/kg) IV 8 hourly

Consider melioidosis in towns north of Port Hedland WA if risk factors exist: diabetes, excessive alcohol intake, chronic lung or renal disease, immune suppression, rheumatic heart disease, malignancy. Replace antibiotic cover with meropenem 25mg/kg up to 1g IV 8 hourly. (See [Melioidosis](#)).

References

1. Therapeutic Guidelines: Severe Sepsis and Septic Shock. eTG complete Melbourne: Therapeutic Guidelines Limited [Internet]. 2017 [cited 2017 Jan 25] Available from: <https://www.tg.org.au>
2. Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-Hari, M., Annane, D., Bauer, M., et al. (2016). The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA : the Journal of the American Medical Association*, 315(8), 801. <http://doi.org/10.1001/jama.2016.0287>
3. Rhodes A, Alhazzani W, et al. Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2016. *Crit Care Med*. 2017;45:1-67.
4. Schmidt GA, Evaluation and management of suspected sepsis and septic shock in adults. UpToDate, Waltham, MA [Internet]. 2017 [cited 2017 Jan 25] Available from: <http://www.uptodate.com>
5. Jones, A. E., Shapiro, N. I., Trzeciak, S., Arnold, R. C., Claremont, H. A., Kline, J. A., & Investigators, F. T. E. M. S. R. N. E. (2010). Lactate Clearance vs Central Venous Oxygen Saturation as Goals of Early Sepsis Therapy: A Randomized Clinical Trial. *JAMA : the Journal of the American Medical Association*, 303(8), 739–746. <http://doi.org/10.1001/jama.2010.158>

7 MENTAL HEALTH

7.1 Transfer of Mental Health Patients

Theory

1. Mental Health patient refers to patients who are being transferred principally because of an acute psychiatric disorder. This does not include patients being carried for other medical or surgical conditions who have an incidental psychiatric condition, which is well controlled.
2. Other patients acutely affected by alcohol, illicit drugs or withdrawal symptoms, or who appear to pose a threat to the safety of a flight should be managed in accordance with these guidelines also, although they are not covered by the Mental Health Act.
3. Our CASA-approved Operations Manual requires us to ensure the safety of passengers and crew during flight. Conditions are imposed on the carriage of patients at risk of becoming disturbed or violent in flight.
4. In the event of an in-flight emergency, there are limited resources on-board an aircraft. This must be borne in mind despite the principles of using the 'least restrictive options' for patients outlined in the Mental Health Act 2014.
5. The term 'at risk' is used to refer to those patients judged to be at risk of behavioural disturbance or violence during flight.
6. Retrieval staff, as registered health professionals, are expected to be familiar with the Mental Health Act and associated Regulations and manage patients accordingly.

Pre-flight and In-flight Management

1. Suitability for aeromedical transport

Does the patient warrant aeromedical transport; that is, requires a stretcher and clinical care during transport? In most cases only patients referred under the Act, who cannot travel by any other public or private means, are accepted. Some transfers may involve involuntary detained patients from one authorised hospital to another. The mental health forms are covered later; the key decisions are to evaluate suitability for air transport and how they should be managed clinically.

2. Flight priority

Most patients are suitable for Priority 3 (routine inter-hospital transfer). However, in smaller hospitals, nursing posts and remote communities that priority may be upgraded at the RFDS doctor's discretion based on concerns for either patient or staff welfare. Patients who are known to be unstable or violent, or who have been awaiting transfer for more than 24 hours should be routinely re-assessed. Patients will be triaged alongside all other patients including those with acute physiological and surgical emergencies taking into account risk of delays to planned interventions for patients. This requires vigilance in times of significant demand where delayed mental health patients may suffer complications of prolonged sedation at referring hospitals. Some patients may be upgraded to a Priority 2 if appropriate.

3. 'At risk' status

The assessing RFDS doctor will determine if the patient is 'at risk (of in-flight violence / disturbance)' in conjunction with the referring doctor / mental health practitioner. Factors to be considered include past history, overt behavioural disturbance, agitation, confusion and delusional ideation. Most patients with major affective disorders (especially schizophrenia and bipolar affective disorder) should be considered at risk.

- a) If **not** 'at risk' of in-flight behavioural disturbance, restraint (chemical or physical) is inappropriate and the patient does **not** require an escort other than a flight nurse.

Alternative means of transport (e.g. routine public transport) should be considered for these patients.

- b) If 'at risk' the patient requires sedation, restraint and an additional escort. Only one such patient may be carried on an aircraft at any one time.

4. Sedation (chemical restraint)

RASS

Sedation should be targeted to a predefined endpoint that ensures both compliance and airway security. We have adopted the Richmond Agitation and Sedation Scale (RASS). The goal of treatment should be a score of -1 to 0. This should be determined at the time of referral for transport and the RASS documented during flight at regular intervals. (See [Richmond Agitation-Sedation Scale \(RASS\)](#)).

Intravenous access

Intravenous access (cannula and injection port) must be in place and well secured prior to transport (patients at risk of pulling out cannulae ought to have two cannulae). Cannulae should ideally not be placed at the wrist due to the position of the restraints used.

Drugs

Our preferred regime for sedation is midazolam 2.5 - 5mg IV or diazepam 2.5 - 5mg IV supplemented with haloperidol 5mg IV, titrated against the clinical response.

Encourage adequate use of pre-flight antipsychotics rather than over reliance on benzodiazepines. For example, olanzapine 5mg p.o. 6 hourly, or zuclopenthixol acetate (Clopixol Accuphase) 50-150mg IM every 2-3 days.

Anaesthetic agents such as ketamine may be used at the discretion of an accompanying doctor. (See [Ketamine for Management of Acutely Agitated Patients](#)).

Monitoring

All patients should have a full set of observations completed at regular intervals during transport, including a temperature at acceptance and discharge.

ECG monitoring should be attempted, particularly for patients receiving large doses of sedation. Patients with mental illness may have other underlying medical conditions.

Careful airway management must be observed, and the patient should have regular S_aO₂ recorded. If heavily sedated, capnometry should be used. (See technique in [Severe Behavioural Disturbance in Paediatric Patients](#)).

5. Physical restraint

Mechanical bodily restraint must be authorised in writing. Orders by an RFDS doctor on a preflight assessment form meet this requirement.

Restraints are not to be removed, even in part, during flight.

6. Escorts

- Patients deemed 'at risk' aeromedically will have a suitable escort in addition to a flight nurse.
- Under the Mental Health Act, patients on a Transport Order (Form 4A, 4B) must be accompanied by a Transport Officer. A Police Officer may be used if a Transport Officer is not available. These meet our requirement for an escort.
- 'At risk' patients not on a Transport Order require an alternative suitable escort provided by the referring location e.g. a community Mental Health Practitioner, Hospital Nurse, Hospital Orderly, or a relative of the patient.

- A doctor escort should be considered when there are significant clinical risk factors such as violent behaviour, forensic history, illicit drug use, high sedation requirement or use of exceptional sedation regimes (infusions and anaesthetic agents).

7. Carriage of psychiatric patients at night

Mentally disturbed patients are not normally carried at night due to limited resources and for safety reasons (risks of disorientation and lack of landing options in an emergency). Many patients would benefit from early sedation and an opportunity to reduce their arousal prior to transfer the next day. In exceptional circumstances, particularly where resources at the referring location are limited, a night flight may be authorised by the assessing RFDS doctor. These flights should be doctor accompanied.

8. Intubation of mental patients for transport purposes

Airway protection

This is reserved for patients who are either not controllable with adequate, appropriate medication and whose sedation requirements put the security of their airway at risk, or have already aspirated as a result of heavy or prolonged sedation. Intubation and ventilation should be implemented at the referring hospital after consultation with the assessing RFDS doctor, and with due reference to the probable flight arrival time. It should not be delayed until the RFDS plane arrives unless at a remote site with no doctor.

Not routine

Giving an anaesthetic to a non-consenting patient is not an 'RFDS requirement' and should be regarded as a last resort. All ventilated cases must be notified as a Clinical Incident as we have a mandatory reporting requirement to the Office of the Chief Psychiatrist. Intubated patients do not require a police escort. Implementation of the RFDS ketamine guideline should reduce the incidence further.

Register of difficult cases

Patients found to be especially challenging should be notified to the SMO or Clinical Coordinator for inclusion in the register maintained for the purpose of informing safe future retrieval planning (eg. Patients with known drug resistance, coexisting morbidities affecting sedation management, previous requirement for intubation).

9. Other interventions

Urinary catheterisation

Urinary catheterisation may be necessary if the patient is heavily sedated and restrained, the flight time **is longer than four hours** and it will not be possible to toilet the patient during flight. This should be explained and performed with consent at the referring hospital prior to flight. It can be perceived as assault, or arouse a docile patient. This should be discussed between the referring and transporting doctors in advance.

Nicotine patches

These may prove invaluable in reducing agitation in smokers.

10. Forms

This can be complex and advice should be sought by escalating within the RFDS to a Clinical Coordinator, Director of Medical Services, or Office of the Chief Psychiatrist.

In general, most patients will be on some of the following:

Form 1A - Referral (valid 72 hrs) with Attachment (confidential). There may also be a Form1B - Variation of referral (changing place of examination, extending the time limit another 72 hrs)

- Form 3A - Detention order (valid 24 hrs), and one or more of
- Form 3B - Continuation of detention (24 hrs each)
- Form 4A - Transport order (valid 72 hrs) and may also be a
- Form 4B - Extension of Transport order (another 72 hrs)
- Form 4C - Transfer order is used for transfer between authorized hospitals
- Form 9A - Record of emergency psychiatric treatment (if used)

Special Notes

1. These guidelines relate to our aeromedical management. Clinical staff should be familiar with the Mental Health Act 2014 and relevant Regulations.
2. A summary of all the Mental Health Act 2014 forms and copies of relevant ones, appear in the following pages. A full set is maintained on the intranet, suitable for printing.
3. If a patient is classified as not 'at risk', yet appears to the RFDS crew on arrival as being 'at risk', then the duty RFDS doctor should be contacted and the procedures for 'at risk' patients followed.
4. An OCP Help Desk for Clinicians will operate 24 hours on **08 9222 4217**
5. Emergency Psychiatric Treatment forms are faxed to **08 9222 4497**

Medical Chest Items

Diazepam 10mg ampoules (Item 98), diazepam 2mg tabs (Item 191)

References

1. Clinicians' Practice Guide to the Mental Health Act 2014, Office of the Chief Psychiatrist, Health Department of Western Australia. (Available on intranet and OCP website).
2. WA Country Health Service. Sedation for Mental Health Patients Awaiting RFDS Transfer from Remote Regions Guideline. Effective: 18 November 2010.
3. Mental Health Act 2014, Government of Western Australia. (Available on intranet).

Notes: Form 1A – Referral for examination by psychiatrist
<p>When to use this form: A medical practitioner or authorised mental health practitioner may refer a person (including a voluntary inpatient – s36) for an examination conducted by a psychiatrist if, having regard to the criteria specified in section 25, the practitioner reasonably suspects that:</p> <ul style="list-style-type: none"> ▪ the person is in need of an involuntary treatment order; or ▪ if the person is under a community treatment order – the person is in need of an inpatient treatment order (s26(1)). <p>If the referred person needs to be detained in order to be taken to the place of examination see <i>Form 3A – Detention Order</i>. If the referred person is in need of a transport order to be taken to the place of examination see <i>Form 4A – Transport Order</i>.</p>
<p>Section 25 criteria for an involuntary treatment order: Criteria for an inpatient treatment order (<u>all</u> of the requirements must be met) (s25(1)):</p> <ol style="list-style-type: none"> a) the person has a mental illness requiring treatment; b) because of the mental illness there is a significant risk to the health or safety of the person or to the safety of another person, or a significant risk of serious harm to the person or to another person; c) the person does not demonstrate the capacity to make a decision about provision of treatment to himself or herself (see Part 5 of Act for consideration of capacity matters); d) treatment in the community <u>cannot</u> reasonably be provided to the person; and e) there is no alternative that would be less restrictive to the person's freedom of choice and movement. <p>Criteria for a community treatment order (<u>all</u> of the requirements must be met) (s25(2)):</p> <ol style="list-style-type: none"> a) the person has a mental illness requiring treatment; b) because of the mental illness there is a significant risk to the health or safety of the person or to the safety of another person, or a significant risk of serious harm to the person or to another person, or a significant risk of the person suffering serious physical or mental deterioration; c) the person does not demonstrate the capacity to make a decision about provision of treatment to himself or herself (see Part 5 of Act for consideration of capacity matters); d) treatment in the community <u>can</u> reasonably be provided to the person; and e) there is no alternative that would be less restrictive to the person's freedom of choice and movement.
<p>Duration of order: A referral remains in force for 72 hours from the time that the referral is made unless:</p> <ul style="list-style-type: none"> ▪ it is a referral made in a non-metropolitan area and is extended (Form 1B – Variation of referral) (s45); or ▪ the referral is revoked (see front of form) (s31, 37).
<p>Place of examination:</p> <ul style="list-style-type: none"> ▪ If the referred person is a voluntary inpatient in an authorised hospital, the place of examination must be the authorised hospital in which the person is an inpatient (s36). ▪ In all other cases the place of examination may be: <ul style="list-style-type: none"> ○ an authorised hospital (s26(2)); or ○ a place that is not an authorised hospital if it is an appropriate place to conduct the examination having regard to the Chief Psychiatrist's guidelines. In this case, the practitioner must make any arrangements that are necessary to enable the examination to be conducted at that place (s26(3)). ▪ The place of examination may be changed (Form 1B – Variation of referral).
<p>Revocation of referral: A medical practitioner or authorised mental health practitioner may make an order revoking a referral if satisfied that the person referred is no longer in need of an involuntary treatment order (s31(1), s37(1)). The practitioner cannot revoke the referral if it was made by another practitioner unless the practitioner has consulted the other practitioner about whether or not to revoke the referral, or despite reasonable efforts to do so, the other practitioner cannot be contacted (s31(2), s37(2)).</p> <p>⚠ If the referred person is being detained under a <i>Form 3A – Detention Order</i> the person must be released (s31(6)). The release of a person following the revocation of a referral is a Notifiable Event which means, where possible, at least one personal support person must be notified that the person has been released.</p>
<p>Checklist of Mental Health Act 2014 requirements related to this form:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Provide the referred person with the information in this referral (you may wish to do this by giving the referred person a copy of this form). <input type="checkbox"/> File the referral on the person's medical record. <input type="checkbox"/> Provide the referred person and at least one personal support person with an explanation of the referred person's rights as soon as practicable. <p>If referral is revoked:</p> <ul style="list-style-type: none"> <input type="checkbox"/> ⚠ If the person was subject to a <i>Form 3A – Detention order</i>, the person must be released. The practitioner revoking the referral must inform at least one personal support person of the release of the person, as soon as practicable. <input type="checkbox"/> If the person was subject to a <i>Form 4A – Transport order</i>, the practitioner revoking the referral must notify the police or transport officer carrying out the transport order and make a record of the advice on the person's medical record. <input type="checkbox"/> File the form with the revocation section completed on the referred person's medical record. <input type="checkbox"/> Give a copy of the form with the revocation section completed to the referred person as soon as practicable.
<p>Information for place where person will be received for examination: Is there an 'Attachment to Form 1A' completed? <input type="checkbox"/> Yes <input type="checkbox"/> No. If yes, ensure receiving place gets a copy of the Attachment along with the Form 1A.</p>

Figure 7.1 Form 1A (cont'd)



 <p>CHIEF PSYCHIATRIST OF WESTERN AUSTRALIA</p> <p>WA MENTAL HEALTH ACT 2014</p> <p>SECTIONS: 26, 36, 41, 42, 43</p>	Please use ID label or block print	
	SURNAME	UMRN
	GIVEN NAMES	CMHI
	BIRTHDATE	SEX
ADDRESS		
ATTACHMENT TO FORM 1A – INFORMATION PROVIDED BY ANOTHER PERSON IN CONFIDENCE		
<p>This attachment is supplementary to <i>Form 1A - Referral</i> and can only be completed in addition to a Form 1A.</p> <p>Form 1A must include the basis on which the practitioner suspects that the referred person is in need of an involuntary treatment order. This may include information communicated to the practitioner by another person. If another person communicated information on the condition that it must <u>not</u> be provided to the referred person, this information must be captured in this attachment. This attachment and the information within it must <u>never</u> be provided to the referred person.</p> <p>Basis on which it is suspected the person is in need of an involuntary treatment order – information communicated to referring practitioner by another person on condition that it must not be provided to the referred person:</p> <div style="border: 1px solid black; height: 250px; width: 100%;"></div>		
<p>Name of referring practitioner: _____</p> <p>Signature of referring practitioner: _____</p> <p style="text-align: right;">Date: DD/MM/YY</p> <p style="text-align: center;">THIS ATTACHMENT MUST <u>NEVER</u> BE GIVEN TO THE REFERRED PERSON</p>		
<p>ATTACHMENT TO FORM 1A REFERRAL – INFORMATION PROVIDED BY ANOTHER PERSON IN CONFIDENCE</p>		

Figure 7.2 Attachment to Form 1A

 CHIEF PSYCHIATRIST OF WESTERN AUSTRALIA WA MENTAL HEALTH ACT 2014 SECTIONS: 45, 46	Please use ID label or block print	
	SURNAME	UMRN
	GIVEN NAMES	CMHI
	BIRTHDATE	SEX
ADDRESS		
FORM 1B – VARIATION OF REFERRAL		
CHANGING PLACE WHERE EXAMINATION BY PSYCHIATRIST WILL BE CONDUCTED		
The place where the examination was to have been conducted: (see Form 1A or any previous Form 1B)		
<input type="checkbox"/> Authorised hospital <input type="checkbox"/> Other place		
The place where, because of this order, the examination will be conducted: (Cannot change the place of examination without consulting with a medical practitioner or an AMHP at the new place of examination to confirm that the person can be received and examined at the place.)		
<input type="checkbox"/> Authorised hospital <input type="checkbox"/> Other place		
Any comments (optional):		
Name of practitioner making this order: _____		
Qualifications: _____ Signature: _____ <input type="checkbox"/> Medical practitioner <input type="checkbox"/> AMHP		
Date and time this order made: _____ Date: DD/MM/YY Time: HH:MM		
EXTENDING A REFERRAL MADE OUTSIDE A METROPOLITAN AREA		
Date and time referral would expire if not extended: Date: DD/MM/YY Time: HH:MM (Refer to Form 1A)		
Date and time referral will expire because of extension: Date: DD/MM/YY Time: HH:MM (72 hours after it would have expired if not extended. Cannot be extended further.)		
Reason for extending referral:		
<input type="checkbox"/> I am satisfied that the referral is likely to expire before the person is received into the authorised hospital or other place.		
Any comments (optional):		
Name of practitioner making this order: _____		
Qualifications: _____ Signature: _____ <input type="checkbox"/> Medical practitioner <input type="checkbox"/> AMHP		
Date and time this order made: _____ Date: DD/MM/YY Time: HH:MM		

FORM 1B – VARIATION OF REFERRAL

Figure 7.3 Form 1B – Variation of Referral

Notes: Form 1B – Variation of referral	
Changing place of examination	<p>A medical practitioner or authorised mental health practitioner may make an order changing the place specified in a referral as the place where the examination by a psychiatrist will be conducted (s46(1)).</p> <p>The practitioner cannot change the place specified in the referral unless the practitioner has consulted a medical practitioner or authorised mental health practitioner at the place where, if the change is made, the examination will be conducted (s46(2)).</p>
Extending a referral made outside a metropolitan area	<p>The referral can be extended when:</p> <ol style="list-style-type: none"> 1. the referral is made outside a metropolitan area; and 2. the person responsible for taking the referred person to the place of examination forms the opinion that the referral is likely to expire before the referred person is received into the hospital or other place; and 3. the person responsible for taking the referred person to the place of examination orally requests an extension of the referral from: <ol style="list-style-type: none"> a) the practitioner who made the referral; or b) if the practitioner who made the referral is not reasonably available, another medical practitioner or authorised mental health practitioner in the same place; or c) if neither of the above are reasonably available, another medical practitioner or authorised mental health practitioner; <p style="margin-left: 20px;">or</p> <p style="margin-left: 20px;">if none of the above are reasonably available, then the person responsible may extend the referral him/herself if he/she is a medical practitioner or authorised mental health practitioner.</p> 4. If the practitioner is satisfied that the referral is likely to expire before the person is received into the authorised hospital or other place then he/she can extend the referral by completing this form (s45). <p>Duration of order:</p> <ul style="list-style-type: none"> ▪ The referral can be extended under this order for a further period of 72 hours from the time when the 72-hour period for which the referral is valid ends (s45). ▪ The referral cannot be extended more than once (s45). ▪ If there is a <i>Form 4A – Transport order</i> in place, the transport order is automatically extended until the referral expires (s151).
<p>Checklist of <i>Mental Health Act 2014</i> requirements related to this form:</p> <p><input type="checkbox"/> Give the referred person a copy of this form as soon as practicable.</p> <p><input type="checkbox"/> File this form on the referred person's medical record.</p> <p>Additionally, if place of examination is changed:</p> <p><input type="checkbox"/> Advise the person responsible for taking the referred person to the place of examination of the change.</p>	

Figure 7.3 Form 1B – Variation of Referral (cont'd)

Notes: Form 3A – Detention Order

When to use this form

When a referred person is on a *Form 1A – Referral for examination by psychiatrist* and the medical practitioner or authorised mental health practitioner is satisfied that a referred person needs to be detained in order to enable the person to be taken to the authorised hospital or other place for an examination by a psychiatrist, the practitioner can make a detention order under this form (s28).

NE This is a **Notifiable Event** which means, where possible, at least one personal support person must be notified of the making of this order.

Duration

- A person can be detained under this order until the time when the order expires, which can be up to 24 hours from the time that the order is made (s28(1)).
- Detention under this order can be continued by a *Form 3B – Continuation of Detention*, for a further 24 hours from the end of the detention period under this form. Form 3B can be used to continue detention multiple times however a person cannot be detained for a total of more than:
 - 72 hours from the time that detention under this form commenced; or
 - 144 hours from the time that detention under this form commenced if the referral was made outside the metropolitan area (s28(3)).
- The person cannot continue to be detained if, by the end of the detention period:
 - the person has not been taken to the place of examination by a psychiatrist; and
 - an order continuing the detention (Form 3B) has not been made; and
 - the person has not been apprehended under a transport order (s28(10)).
- The person cannot continue to be detained if the referral expires before the person arrives at the place of examination by a psychiatrist (s28(11)).

Principles of detention

The following principles apply in relation to the detention of a person:

- the person must be detained for as brief a period as practicable;
- the degree of any force used to detain the person must be the minimum that is required to be used for that purpose;
- while the person is detained —
 - there must be the least possible restriction on the person's freedom of choice and movement consistent with the person's detention; and
 - the person is entitled to reasonable privacy consistent with the person's detention; and
 - the person must be treated with dignity and respect (s170).

Related forms

- A *Form 4A – Transport order* can be made to take the person to the place of examination / the hospital.

Checklist of *Mental Health Act 2014* requirements related to this form:


Notes

- NE** Notify at least one personal support person that this order has been made, as soon as practicable.
- Give the referred person a copy of this form as soon as practicable.
- File this form on the referred person's medical record.
- Ensure that the person has the opportunity and means to contact any personal support person, any health professional currently providing treatment to the person and the Mental Health Advocacy Service as soon as practicable and at all reasonable times while the person is detained.

Figure 7.4 Form 3A – Detention Order (cont'd)

Notes: Form 3B – Continuation of detention	
<p>Continuation of detention under <i>Form 3A – Detention order.</i></p> <ul style="list-style-type: none"> ▪ Detention under a Form 3A can be continued for up to a further 24 hours by this form (Form 3B) if: <ul style="list-style-type: none"> ○ immediately before making the order, a medical practitioner or authorised mental health practitioner assesses the person; and ○ as a consequence, the practitioner is satisfied that the person still needs to be detained to enable the person to be taken to the place of examination by a psychiatrist (s28). ▪ Detention can be continued using a Form 3B multiple times, however the person cannot be detained under Forms 3A & 3B for a total period of more than 72 hours (or 144 hours if the referral is made outside a metropolitan area) (s28). 	
<p>Continuation of detention of a person who is received into a place outside a metro area that is not an authorised hospital, to enable examination by a psychiatrist.</p> <p>A person referred to an examination at a place that is not an authorised hospital, must be received at the place and can be detained there for up to 24 hours in order for an examination by a psychiatrist to occur. If:</p> <ul style="list-style-type: none"> ▪ the place is outside a metropolitan area; and ▪ it is not practicable to complete the examination within the 24-hour period <p>a medical practitioner or authorised mental health practitioner at the place may make an order continuing the person's detention at the place, to enable the examination to be completed, for up to an additional 48 hours from the end of the 24-hour period (s59).</p>	
<p>Continuation of detention to enable the person placed on an '<i>inpatient treatment order in a general hospital</i>' (Form 6B) to be taken to the general hospital.</p> <p>Following a psychiatrist at a place that is not an authorised hospital making an '<i>inpatient treatment order in a general hospital</i>' (Form 6B) in respect of a person, the psychiatrist (or a medical practitioner or authorised mental health practitioner) can make an order continuing a person's detention at that place, if satisfied that the person needs to be detained in order to enable the person to be taken to the general hospital (s62). Detention can be continued for up to 24 hours from the time that the Form 6B was made (s62).</p>	
<p>Continuation of detention to enable a person placed on an '<i>order authorising reception and detention of person in authorised hospital</i>' (Form 3D) to be taken to the authorised hospital (s62).</p> <p>Following a psychiatrist making an '<i>order authorising reception and detention of person in authorised hospital</i>' (Form 3D) in respect of a person, the psychiatrist (or a medical practitioner or authorised mental health practitioner) can make an order continuing a person's detention at that place, if satisfied that the person needs to be detained in order to enable the person to be taken to the hospital (s62). Detention can be continued for up to 24 hours from the time that the Form 3D was made (s62).</p>	
<p>Checklist of <i>Mental Health Act 2014</i> requirements related to this form:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Give the person a copy of this form as soon as practicable. <input type="checkbox"/> File this form on the person's medical record. <input type="checkbox"/> Ensure that the person has the opportunity and means to contact any personal support person, any health professional currently providing treatment to the person and the Mental Health Advocacy Service as soon as practicable and at all reasonable times when the person is detained. 	<p><u>Notes</u></p>

Figure 7.5 Form 3B – Continuation of Detention (cont'd)

 CHIEF PSYCHIATRIST OF WESTERN AUSTRALIA WA MENTAL HEALTH ACT 2014 SECTIONS: 29,63,67,92,112,129,133,148, 154	Please use ID label or block print	
	SURNAME	UMRN
	GIVEN NAMES	CMHI
	BIRTHDATE	SEX
	ADDRESS	
FORM 4A – TRANSPORT ORDER		
<p>To the transport officer or police officer: This order authorises you to apprehend the person named in this order and transport him or her to the place specified below.</p> <p>Place from which person is to be transported: _____ <input type="checkbox"/> Metro area <input type="checkbox"/> Non-metro area</p> <p>Place to which person is to be transported: _____</p> <p>Reasons for making transport order: I am satisfied that the –</p> <p><input type="checkbox"/> referred person needs to be taken to the place for examination by psychiatrist; <input checked="" type="radio"/> OR</p> <p><input type="checkbox"/> person needs to be taken to general hospital to be detained under inpatient treatment order; OR</p> <p><input type="checkbox"/> person needs to be taken to authorised hospital for further examination by psychiatrist; OR</p> <p><input type="checkbox"/> involuntary inpatient in general hospital needs to be taken to authorised hospital following a transfer order; OR</p> <p><input type="checkbox"/> involuntary inpatient in authorised hospital needs to be taken to another authorised hospital following a transfer order; OR</p> <p><input type="checkbox"/> involuntary inpatient on leave of absence to obtain medical or surgical treatment at a general hospital to be taken to the general hospital; OR</p> <p><input type="checkbox"/> involuntary inpatient on leave of absence that expires or is cancelled needs to be taken to hospital; OR</p> <p><input type="checkbox"/> involuntary community patient not complying with order to attend needs to be taken to specified place; <input checked="" type="radio"/> OR</p> <p><input type="checkbox"/> involuntary community patient needs to be taken to hospital as involuntary inpatient;</p> <p>AND</p> <p><input type="checkbox"/> No other safe means of taking the person is reasonably available.</p> <p>Officer responsible for carrying out this order: <input type="checkbox"/> Police officer and/or <input type="checkbox"/> Transport officer</p> <p>If police officer, reason for this:</p> <p><input type="checkbox"/> I am satisfied that there is a significant risk of serious harm to the person being transported or to another person.</p> <p>OR</p> <p><input type="checkbox"/> I am satisfied that a transport officer will not be available to carry out the order within a reasonable time; and any delay in carrying out the order beyond that time is likely to pose a significant risk of harm to the person being transported or to another person.</p> <p>If applicable, please note any special factors or other important details about the person being transported relevant to this order being carried out:</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>Name of the practitioner making the order: _____</p> <p>Qualifications: _____ Signature: _____</p> <p style="font-size: small;"><input type="checkbox"/> Psychiatrist <input type="checkbox"/> Medical practitioner <input type="checkbox"/> AMHP</p> <p>Date and time order made: _____ Date: DD/MM/YY Time: HH:MM</p> <p>Date and time order will expire: _____ Date: DD/MM/YY Time: HH:MM <small>(See overleaf for duration of order)</small></p>		
<p>REVOCATION OF TRANSPORT ORDER (if required)</p> <p>Reasons for revoking transport order:</p> <p><input type="checkbox"/> Automatically revoked because a referral has been revoked; OR</p> <p><input type="checkbox"/> I am satisfied that the transport order is no longer needed.</p> <p>Name of revoking practitioner: _____ Date: DD/MM/YY Time: HH:MM</p> <p>Qualifications: _____ Signature: _____</p>		

FORM 4A – TRANSPORT ORDER

Figure 7.6 Form 4A – Transport Order

Notes: Form 4A – Transport Order		
<p>The transport order can be made in one of the below circumstances if the psychiatrist, medical practitioner or AMHP is satisfied that a transport order needs to be made and there is no other safe means reasonably available to take the person to the place.</p>		
Circumstances for making transport order:	Can be made by:	Duration of order:
Referred person to be taken to authorised hospital or other place for examination by psychiatrist (following Form 1A) NE	Medical practitioner or AMHP	Ends when the referral expires, unless referral is extended or revoked, in which case transport order is automatically extended or revoked.
Person to be taken to general hospital and detained under inpatient treatment order (following Form 6B)	Psychiatrist	72 hours after inpatient treatment order in general hospital (Form 6B) is made. Unless extended or revoked using a Form 4B.
Person at place other than authorised hospital to be taken to authorised hospital for further examination (following Form 3D)	Psychiatrist	72 hours after order authorising reception and detention in authorised hospital for further examination (Form 3C) is made. Unless extended or revoked using a Form 4B.
Involuntary inpatient in general hospital to be transferred to authorised hospital (following Form 4D)	Psychiatrist	72 hours after transport order made. Unless extended or revoked using a Form 4B.
Involuntary inpatient in authorised hospital to be transferred to another authorised hospital (following Form 4D).	Psychiatrist	72 hours after transport order made. Unless extended or revoked using a Form 4B.
Involuntary inpatient on leave of absence to obtain medical or surgical treatment at a general hospital to be taken to the general hospital (following Form 7A).	Psychiatrist	72 hours after transport order made. Unless extended or revoked using a Form 4B.
Involuntary inpatient on leave of absence that expires or is cancelled to be taken to hospital (following a Form 7C or an expiry of Form 7A)	Psychiatrist	72 hours after transport order made. Unless extended or revoked using a Form 4B.
Involuntary community patient not complying with order to attend to be taken to specified place (following Form 5F) NE	Medical practitioner or AMHP	72 hours after transport order made. Unless extended or revoked using a Form 4B.
Involuntary community patient to be taken to hospital as involuntary inpatient (following Form 6A)	Medical practitioner or AMHP	72 hours after transport order made. Unless extended or revoked using a Form 4B.
<p>NE The making of a transport order in these circumstances is a Notifiable Event which means, where possible, at least one personal support person must be notified about the making of the order.</p>		
<p>Related forms:</p> <ul style="list-style-type: none"> ▪ <i>Form 4B – Extension of transport order</i> can be used to extend a transport order when the person is being transported from a place outside a metropolitan area. 		
<p>When police officer can carry out a transport order:</p> <p>A transport order can only authorise a police officer instead of a transport officer to carry out the order if the practitioner or psychiatrist making the order is satisfied:</p> <ul style="list-style-type: none"> ▪ that there is a significant risk of serious harm to the person being transported or to another person; or ▪ that — a transport officer will not be available to carry out the order within a reasonable time; and — any delay in carrying out the order beyond that time is likely to pose a significant risk of harm to the person being transported or to another person (s149(2)). 		
<p>Revocation of transport order:</p> <ul style="list-style-type: none"> ▪ A medical practitioner or mental health practitioner may make an order revoking a transport order made in respect of a person if satisfied that the transport order is no longer needed (s154). ▪ If the transport order is made to take a referred person to the place of examination and the referral is revoked, the transport order is automatically revoked (s153). 		
<p>Checklist of <i>Mental Health Act 2014</i> requirements related to this form:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Give the person a copy of this form as soon as practicable. <input type="checkbox"/> File this form on the person's medical record. <input type="checkbox"/> Give a copy of this form to the transport officer or police officer responsible for carrying out the order. <input type="checkbox"/> NE If the making of the transport order is a Notifiable Event, notify at least one personal support person of the making of the order. 		Notes
<p>If transport order revoked:</p> <ul style="list-style-type: none"> <input type="checkbox"/> File this form with the revocation section completed on the person's medical record <input type="checkbox"/> Give a copy to the transport officer or police officer responsible for carrying out the order <input type="checkbox"/> Give a copy to the person. <p>(Not a requirement if transport order is revoked automatically following a revocation of the referral).</p>		

Figure 7.6 Form 4A – Transport Order (cont'd)

Notes: Form 4B – Extension of transport order**When to use this form**


- If there is a *Form 4A – Transport order* made and:
 - The place from which the person is being transported is outside a metro area; and
 - The transport officer or police officer who is transporting the person forms the opinion that the transport order is likely to expire before the person is received to the place where they are being transported,the transport officer or police officer may orally request an extension of the transport order from a medical practitioner or mental health practitioner (s152(3)).
- The practitioner may make an order orally extending the transport order for a further period of up to 72 hours, and must as soon as practicable complete this form (s152(4)).
- The transport order cannot be extended more than once (s152(5)).

Note: If a referral is extended and there is a transport order in place, this form does not need to be completed because the transport order is automatically extended.

Checklist of *Mental Health Act 2014* requirements related to this form:**Notes**

- Give the person a copy of this form as soon as practicable.
- File this form on the person's medical record.
- Give a copy of this form to the transport officer or police officer responsible for carrying out the order.

Figure 7.7 Form 4B – Extension of Transport Order (cont'd)

 CHIEF PSYCHIATRIST OF WESTERN AUSTRALIA WA MENTAL HEALTH ACT 2014 SECTIONS: 66, 91	Please use ID label or block print	
	SURNAME	UMRN
	GIVEN NAMES	CMHI
	BIRTHDATE	SEX
	ADDRESS	
FORM 4C – TRANSFER ORDER		
This is an order to: <input type="checkbox"/> transfer an involuntary inpatient on a <i>Form 6A – Inpatient treatment order in an authorised hospital</i> from one authorised hospital to another. NE OR <input type="checkbox"/> transfer an involuntary inpatient on a <i>Form 6B - Inpatient treatment order in a general hospital</i> from the general hospital to an authorised hospital. NE		
Hospital from which person is being transferred: _____		
Authorised hospital to which the person is being transferred: _____		
Reasons for the transfer:		
<div style="border: 1px solid black; min-height: 180px;"></div>		
Name of the psychiatrist making the order: _____		
Qualifications of the psychiatrist making the order: _____		
Signature of the psychiatrist making the order: _____		
Date and time order made:		Date: DD/MM/YY Time: HH:MM

FORM 4C – TRANSFER ORDER

Figure 7.8 Form 4C – Transfer Order

Notes: Form 4C – Transfer order

When to use this form:

1. If a person is detained at an authorised hospital under a *Form 6A – Inpatient treatment order in an authorised hospital*, the treating psychiatrist (or if a treating psychiatrist is not reasonably available, another psychiatrist at the authorised hospital) may make a transfer order using this form, authorising the involuntary inpatient's transfer from the authorised hospital to another authorised hospital specified in the order (s91).

Or

2. If:
 - a person is under a *Form 6B – Inpatient order in a general hospital*, and
 - the treating psychiatrist is satisfied that attempting to take the involuntary inpatient to an authorised hospital no longer poses a significant risk to the inpatient's physical health, then the treating psychiatrist can make a transfer order using this form, authorising the inpatient's transfer to the authorised hospital (s66).

NE The making of the transfer order is a **Notifiable Event** which means, where possible, at least one personal support person must be notified about the making of this order.

Transport order:


- A psychiatrist may make a *Form 4A - Transport order* in respect of the involuntary inpatient under the transfer order if satisfied that no other safe means of taking the involuntary inpatient to the authorised hospital is reasonably available (s67, s92).

Checklist of *Mental Health Act 2014* requirements related to this form:

Notes

- NE** Notify at least one of the involuntary inpatient's personal support persons of the making of this order.
- Give the involuntary inpatient a copy of this form as soon as practicable.
- File this form on the involuntary inpatient's medical record.

Figure 7.8 Form 4C – Transfer Order (cont'd)

 <p>CHIEF PSYCHIATRIST OF WESTERN AUSTRALIA</p> <p>WA MENTAL HEALTH ACT 2014</p>	Please use ID label or block print	
	SURNAME	UMRN
	GIVEN NAMES	CMHI
	BIRTHDATE	SEX
	ADDRESS	
SECTION: 204		
FORM 9A – RECORD OF EMERGENCY PSYCHIATRIC TREATMENT		
<p>Does the person have an Advance Health Directive? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown</p>		
<p>Date and time that emergency psychiatric treatment was provided to the person: _____ Date: DD/MM/YY Time: HH:MM</p>		
<p>Place where emergency psychiatric treatment was provided to the person: _____</p>		
<p>Particulars of the circumstances in which the treatment was provided:</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div>		
<p>Particulars of the treatment provided:</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div>		
<p>Name of medical practitioner who provided the treatment: _____</p>		
<p>Qualifications of medical practitioner who provided the treatment: _____</p>		
<p>Signature of medical practitioner who provided the treatment: _____</p>		
<p>Names of any other people involved in providing the treatment:</p> <div style="border: 1px solid black; height: 50px; width: 100%;"></div>		

FORM 9A – RECORD OF EMERGENCY PSYCHIATRIC TREATMENT

Figure 7.9 Form 9A – Record of Emergency Psychiatric Treatment

Notes: Form 9A – Record of emergency psychiatric treatment	
<p>When to use this form:</p> <p>A medical practitioner may provide a person with emergency psychiatric treatment without informed consent being given to the provision of the treatment (s203).</p> <p>A medical practitioner who provides emergency psychiatric treatment to a person must record the provision of the treatment to the person in this form (s204).</p> <p>Emergency psychiatric treatment can be provided to any person, including a voluntary patient or a referred person.</p>	
<p>Definition of emergency psychiatric treatment:</p> <p>Emergency psychiatric treatment is treatment that needs to be provided to a person:</p> <ul style="list-style-type: none"> ▪ to save the person's life; or ▪ to prevent the person from behaving in a way that is likely to result in serious physical injury to the person or another person (s202(1)). <p>Emergency psychiatric treatment does not include any of the following treatments:</p> <ul style="list-style-type: none"> ▪ electroconvulsive therapy; ▪ psychosurgery; and ▪ prohibited treatments (deep sleep therapy, insulin coma therapy, insulin sub coma therapy) (s202(2)). 	
<p>Checklist of Mental Health Act 2014 requirements related to this form:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Give the person a copy of this form as soon as practicable. <input type="checkbox"/> File this form on the person's medical record. <input type="checkbox"/> <input checked="" type="checkbox"/> Give a copy of this form to the Chief Psychiatrist. <input type="checkbox"/> <input checked="" type="checkbox"/> If the person is a mentally impaired accused, give a copy of this form to the Mentally Impaired Accused Review Board. 	<p style="text-align: center;">Notes</p>

Figure 7.9 - Form 9A – Record of Emergency Psychiatric Treatment

7.2 List of Mental Health Act 2014 Forms

Table 7.1 Mental Health Forms Summary

Pack 1 – Referral of person for an examination by a psychiatrist

Form Number	Form Name	Sections of the Act referred to
1A	REFERRAL FOR EXAMINATION BY PSYCHIATRIST ATTACHMENT TO FORM 1A – INFORMATION PROVIDED BY ANOTHER PERSON IN CONFIDENCE	26, 31, 36, 37, 41, 42, 43
1B	VARIATION OF REFERRAL	45, 46

Pack 2 – Order for assessment of a voluntary inpatient

Form Number	Form Name	Sections of the Act referred to
2A	ORDER FOR ASSESSMENT OF VOLUNTARY INPATIENT	34, 35

Pack 3 – Detention of a person to enable a person to be taken to a place, or to enable an examination by a psychiatrist

Form Number	Form Name	Sections of the Act referred to
3A	DETENTION ORDER	28, 62
3B	CONTINUATION OF DETENTION	28, 59, 62
3C	CONTINUATION OF DETENTION FOLLOWING EXAMINATION BY PSYCHIATRIST	55, 56
3D	ORDER AUTHORISING RECEPTION AND DETENTION OF PERSON IN AUTHORISED HOSPITAL	61
3E	ORDER THAT PERSON CANNOT CONTINUE TO BE DETAINED	72

Pack 4 – Detention of a person to enable a person to be taken to a place, or to enable an examination by a psychiatrist

Form Number	Form Name	Sections of the Act referred to
4A	TRANSPORT ORDER	29, 63, 67, 92, 112, 129, 133, 148, 154
4B	EXTENSION OF TRANSPORT ORDER	152
4C	TRANSFER ORDER	66, 91
4E	INTERSTATE TRANSFER ORDER	555
4F	INTERSTATE TRANSFER APPROVAL ORDER	557

Table 7.1 Mental Health Forms Summary (cont'd)

Pack 5 – Community treatment order

Form Number	Form Name	Sections of the Act referred to
5A	COMMUNITY TREATMENT ORDER ATTACHMENT TO 5A – TERMS OF CTO	55, 56, 61, 72, 75, 76, 89, 90, 120, 123, 131
5B	CONTINUATION OF COMMUNITY TREATMENT ORDER	121
5C	VARIATION OF COMMUNITY TREATMENT ORDER	122, 135, 137
5D	REQUEST MADE BY A SUPERVISING PSYCHIATRIST FOR A PRACTITIONER TO CONDUCT THE MONTHLY EXAMINATION OF A PATIENT	118, 119
5E	NOTICE AND RECORD OF BREACH OF COMMUNITY TREATMENT ORDER	127
5F	ORDER TO ATTEND	128

Pack 6 – Inpatient treatment order

Form Number	Form Name	Sections of the Act referred to
6A	INPATIENT TREATMENT ORDER IN AUTHORISED HOSPITAL	55, 56, 72, 120, 123, 131
6B	INPATIENT TREATMENT ORDER IN GENERAL HOSPITAL ATTACHMENT TO FORM 6B – INPATIENT TREATMENT ORDER IN GENERAL HOSPITAL: REPORT TO CHIEF PSYCHIATRIST	61, 89, 90, 131
6C	CONTINUATION OF INPATIENT TREATMENT ORDER	89
6D	CONFIRMATION OF INPATIENT TREATMENT ORDER	68, 124

Pack 7 – Grant of leave of absence and absence without leave

Form Number	Form Name	Sections of the Act referred to
7A	GRANT OF LEAVE TO INVOLUNTARY INPATIENT	105
7B	EXTENSION, VARIATION OR CANCELLATION OF GRANT OF LEAVE	106, 110
7C	CANCELLATION OF GRANT OF LEAVE	110
7D	RETURN ORDER	98, 101

Table 7.1 Mental Health Forms Summary (cont'd)

Pack 8 – Search and seizure of articles

Form Number	Form Name	Sections of the Act referred to
8A	RECORD OF SEARCH AND SEIZURE	165, 166
8B	RECORD OF RETURN OF SEIZED ARTICLE	167

Pack 9 – Emergency treatment

Form Number	Form Name	Sections of the Act referred to
9A	RECORD OF EMERGENCY PSYCHIATRIC TREATMENT	204
9B	REPORT TO CHIEF PSYCHIATRIST ABOUT PROVISION OF URGENT NON-PSYCHIATRIC TREATMENT	242

Pack 10 – Bodily restraint

Form Number	Form Name	Sections of the Act referred to
10A	AUTHORISATION OF BODILY RESTRAINT	230, 231, 233, 234, 235, 237, 239

Pack 11 – Seclusion

Form Number	Form Name	Sections of the Act referred to
11	AUTHORISATION OF SECLUSION	214, 215, 217, 219, 221, 222, 223

Pack 12 – Communication and Information

Form Number	Form Name	Sections of the Act referred to
12A	NOMINATION OF NOMINATED PERSON	275
12B	RESTRICTION ON FREEDOM OF COMMUNICATION	262
12C	REFUSAL OF REQUEST TO ACCESS RECORDS	248

Other

Form Number	Form Name	Sections of the Act referred to
13	STATISTICS ABOUT ECT	201
14	REPORT OF NOTIFIABLE INCIDENT	526

Reference

1. Clinicians' Practice Guide to the Mental Health Act 2014, Office of the Chief Psychiatrist, Health Department of Western Australia. Edition 2. November 2015.

7.3 Ketamine for Management of Acutely Agitated Patients

Theory

Acutely disturbed patients are a risk for aeromedical transport. In addition to physical restraint and additional escorts, they need safe and effective sedation.

Some patients require very large doses of conventional sedation (benzodiazepines and antipsychotics) which pose an airway risk or cause other complications. Some patients are subsequently intubated and ventilated to achieve safe transfer, which is not ethically sound for patients primarily with a mental health problem.

Ketamine has been used to manage acutely disturbed patients and there is anecdotal and limited published evidence of its efficacy and safety.

Two scenarios may present.

- a. Management of acute severe agitation or violence, not responding to other treatment, where Ketamine is given as a single IM dose to achieve control.
- b. Management of severe agitation during aeromedical transfer, where Ketamine is given by infusion to minimize risks of excessive sedation and avoid intubation.

This guideline provides indications and contraindications for the use of Ketamine to manage acute severe agitation and for relatively short duration air transport by RFDS medical staff.

Pre-flight Assessment

The usual scenario will be an acutely disturbed patient requiring transfer to a Mental Health unit. Preflight assessment should, in addition to normal clinical details and vital signs, ensure the following details are obtained.

- A summary of the drugs and total doses administered so far.
- Assessment of the level of agitation-sedation using the RASS score.
- Any significant co-morbidities (respiratory, cardiac, renal, diabetes).
- Previous difficult aeromedical transfer for a MH problem (refer to online Register).
- Check on empty bladder, need for nicotine patch, and other preventable causes of agitation.
- Is the patient fasted?

The flight will be doctor-accompanied.

A Police escort will still be required if the patient is on Mental Health forms.

The referring hospital should NOT be advised to administer Ketamine whilst awaiting the RFDS aircraft.

Patient preparation and In-flight Management

Consider this an anaesthetic and ensure full monitoring and resuscitation facilities are available.

Provide 'premedication' with other agents such as benzodiazepines, antipsychotics and antiemetic.

Contraindications and adverse reactions to Ketamine are listed at the end of this guideline.

1. Ketamine may be administered as a **single intramuscular dose at 4mg/kg** if management of an acutely agitated patient is required and intravenous access is not possible. IV access can then be obtained.
2. Ketamine should preferably be given as an **initial IV bolus dose of 0.5-1.0mg/kg**. (*Should work within 30 seconds and last for about 10 minutes.*)

Follow with similar intermittent bolus doses of 0.5-1.0mg/kg as required.

3. If two bolus doses required in first hour, commence **infusion at 1-1.5mg/kg/hour**.

(IV route is quick onset and offset. You should be able to deliver an “awake” patient at the receiving hospital.)

Titrate the dose to achieve a target sedation level of a calm, cooperative patient who can still respond to verbal commands. RASS score = 0 to -2

There is no maximum dose but exercise caution in exceeding 10mg/kg or 1000mg.

Administer oxygen by simple face-mask

Elevate stretcher backrest to improve spontaneous ventilation and minimize risk of aspiration.

Provide continuous monitoring of S_aO₂, NIBP and ECG.

Use continuous ETCO₂ monitoring via nasal sidestream CO₂ monitor on Zoll, (See [Severe Behavioural Disturbance in Paediatric Patients](#))

Patients must be physically restrained and escorted as per normal MH guidelines.

Note mental health hospitals are not suitable for “recovering” patients who have effectively had an anaesthetic. Decide on the patient destination, based on total sedation received and ability to deliver patient who is not obtunded, mildly sedated with a secure airway. Confirm in flight. *(Consider SCGH ED for Graylands patients, RPH or PMH for Bentley patients.)*

Contraindications

Severe hypertension, recent myocardial infarction, history of stroke, cerebral trauma, intra-cerebral mass or haemorrhage, severe cardiovascular disease.

Age is not a contraindication. May be used in adolescents.

Adverse Reactions

Common: transient hypertension, tachycardia, increased muscle tone.

Infrequent: nausea and vomiting, hypotension and bradycardia, pain on injection.

Rare: apnoea, laryngeal spasm, arrhythmias.

Side-effects

Emergence reactions including vivid dreams, hallucinations, confusion and restlessness (12%).

Use benzodiazepine premedication. These reactions may last several hours and are less frequent with IM administration, in the young and the elderly.

Administration

Dilute for intravenous use to 10mg/mL (500mg diluted to 50mL or 200mg to 20mL)

Administered slowly over 1 minute.

Compatible with 0.9% Normal Saline, and Dextrose 5%.

Special Notes

Dosage should be based on the patient's estimated lean body mass.

References

1. Australian Medicines Handbook. Adelaide: Australian Medicines Handbook Pty Ltd; 2017
2. Le Cong M, Gynther B, Hunter E, et al. Ketamine sedation for patients with acute agitation and psychiatric illness requiring aeromedical retrieval. *Emerg Med J* 2012;29:4 335-337
3. Bredmose PP, et al. Pre-hospital use of Ketamine for analgesia and procedural sedation. *Emerg Med J* 2009;26:1 62-64

7.4 Richmond Agitation-Sedation Scale (RASS)

Theory

1. Patients with acute mental illness, substance abuse, drug overdose or other clinical conditions can exhibit a spectrum of behaviour from extreme agitation to heavy sedation.
2. An objective assessment tool can be used to describe this more accurately. The Glasgow Coma Scale was developed for ranking the level of coma in head injured patients. It was not designed for assessing sedated patients, nor does it score increased levels of arousal.
3. The Richmond Agitation-Sedation Scale (RASS) has been widely used in Intensive Care environments to help communicate the status of patients in a standardised manner and to enable titration of sedation to an optimal level.
4. The RASS has application for aeromedical practice in helping to better communicate and record patient behaviour in a standardised manner.
5. The RASS ranges from +4 to -5. At one extreme, +4 represents a very combative, violent patient, who is considered dangerous to staff. At the other extreme, -5 represents a patient who is unrousable, with no response to voice or physical stimulation. A score of 0 equates with a patient who is alert and calm. (See table attached.)

Pre-flight and In-flight Management

1. RFDS doctors are encouraged to try and score patients when assessing a flight request. With time we may be able to encourage widespread use throughout the health system.
2. A RASS should be conducted when accepting a patient at handover and recorded on our In-flight Observation and Treatment sheets.
3. A RASS can be used in flight to document peaks of agitation or sedation, particularly in relation to administration of drugs. Patients should ideally have a target score of 0.
4. A RASS should also be recorded prior to handover at the receiving end. Recording of this score provides a quantitative measure of agitation or sedation which will be useful when cases are audited. We can add the RASS to our electronic records.
5. The formal assessment requires no more than three steps: observing the patient, or speaking to them, or physical stimulation.

Table 7.2. Richmond Agitation Sedation Scale (RASS)

Richmond Agitation-Sedation Scale (RASS)		
Score	Term	Description
+4	Combative	Overtly combative, violent, immediate danger to staff
+3	Very agitated	Pulls or removes tube(s) or catheter(s); aggressive
+2	Agitated	Frequent non-purposeful movement, fights ventilator
+1	Restless	Anxious but movements not aggressive vigorous
0	Alert and calm	
-1	Drowsy	Not fully alert, but has sustained awakening (eye-opening/eye contact) to <i>voice (>10 seconds)</i>
-2	Light sedation	Briefly awakens with eye contact to <i>voice (<10 seconds)</i>
-3	Moderate sedation	Movement or eye opening to <i>voice (but no eye contact)</i>
-4	Deep sedation	No response to voice, but movement or eye opening to <i>physical stimulation</i>
-5	Unroutable	No response to <i>voice or physical stimulation</i>

Procedure

Observe patient

- Is patient alert and calm? **(score 0)**
- Is the patient restless, agitated or combative **(score +1 to +4)**
- If patient is not alert, in a **loud speaking voice**, state patient's name and direct patient to open eyes and look at speaker. Repeat once if necessary. Can prompt patient to continue looking at speaker.
- Patient has eye opening and eye contact, which is sustained for more than 10 seconds. **(score -1)**.
- Patient has eye opening and eye contact, but this is not sustained for 10 seconds. **(score -2)**.
- Patient has any movement in response to voice, excluding eye contact? **(score -3)**.
- If patient does not respond to voice, **physically stimulate** patient by shaking shoulder and then rubbing sternum if there is no response to shaking shoulder.
- Patient has any movement to physical stimulation **(score -4)**.
- Patient has no response to voice or physical stimulation **(score -5)**.

References

1. Sessler CN, Gosnell M, Grap MJ, Brophy GT, O'Neal PV, Keane KA et al. The Richmond Agitation-Sedation Scale: validity and reliability in adult intensive care patients. *Am J Respir Crit Care Med* 2002; 166:1338-1344.
2. Ely EW, Truman B, Shintani A, Thomason JWW, Wheeler AP, Gordon S et al. Monitoring sedation status over time in ICU patients: the reliability and validity of the Richmond Agitation Sedation Scale (RASS). *JAMA* 2003; 289:2983-2991.

7.5 Severe Behavioural Disturbance in Paediatric Patients

Theory

Children may present with an acute behavioural disturbance as a result of a number of potential and possibly co-existing causes. These include: intoxication, substance abuse, organic processes, psychiatric illness, social disruption. Consider issues such as brain injury from foetal alcohol syndrome, solvent abuse and illicit drugs. Histories of abuse and neglect may also feature prominently.

Modifications to sedation protocols need to be made to account for differing pharmacokinetics and needs to adults.

The key principles of patient, staff and aircraft safety still need to be adhered to.

Pre-flight management

1. Exclusion of organic causes for behavioural disturbance must have taken place to the best of the referring location's capacity. For more isolated locations this may require the assessing RFDS doctor to manage.
2. Referring locations should ensure parents, guardians and competent minors are informed of the process and the likely need for physical restraint and sedation in flight.
3. During the pre-flight assessment the assessing doctor should enquire about features that may point to risk of violence and resistance to certain drug groups. (See [The Deteriorating Patient](#)).
4. Longer acting oral sedation (e.g. Lorazepam or Olanzapine) may be given pre-flight however adequate intravenous access should be in place in case rapid sedation is required in flight. Dosing: Lorazepam-oral 0.02– 0.06mg/kg 8-24 hourly, Diazepam – oral 0.2-0.4mg/kg 8-12 hourly, Olanzapine 0.1-0.2mg/kg/day. Note Lorazepam will need to be sourced from referring or base hospital.
5. Careful consideration should be given to the choice of escort and the likely behaviour of that escort in terms of capacity to calm rather than inflame the situation. A police officer may still be the best choice for particularly violent patients.
6. All children under 16 should be accompanied by an RFDS doctor.
7. Referring doctors must be informed that Bentley Hospital Adolescent Unit is not able to receive patients who have had sedation. Patients who are intended for this unit may need to also be referred to PMH (or RPH / FSH if over 15 years old). for medical clearance.
8. Care of nutrition, hydration and bladder must be attended to. Ensure patient has voided pre-flight. If heavily sedated may need catheterisation however this is a very invasive procedure and may be unreasonably traumatic for a child. If sedation heavy keep fasted.

In-flight management

1. The choice of drugs used for sedation should take in to account the following problems:

Disinhibition with benzodiazepines

This is more common in the paediatric population in particular those with organic brain disease, substance abuse, learning disabilities and impulse control problems. If after two doses of benzodiazepine the desired affect is not achieved consider a different pharmacological group.

Respiratory depression

Supplemental O₂ should be given and continuous S_aO₂ monitoring. Heavily sedated patients should have continuous capnometry monitoring, this can be achieved by using the Smart CapnoLine® combine nasal prongs and ETCO₂ sensor. Whilst this does not measure absolute ETCO₂ it provides a trend in rate and depth of respiration.

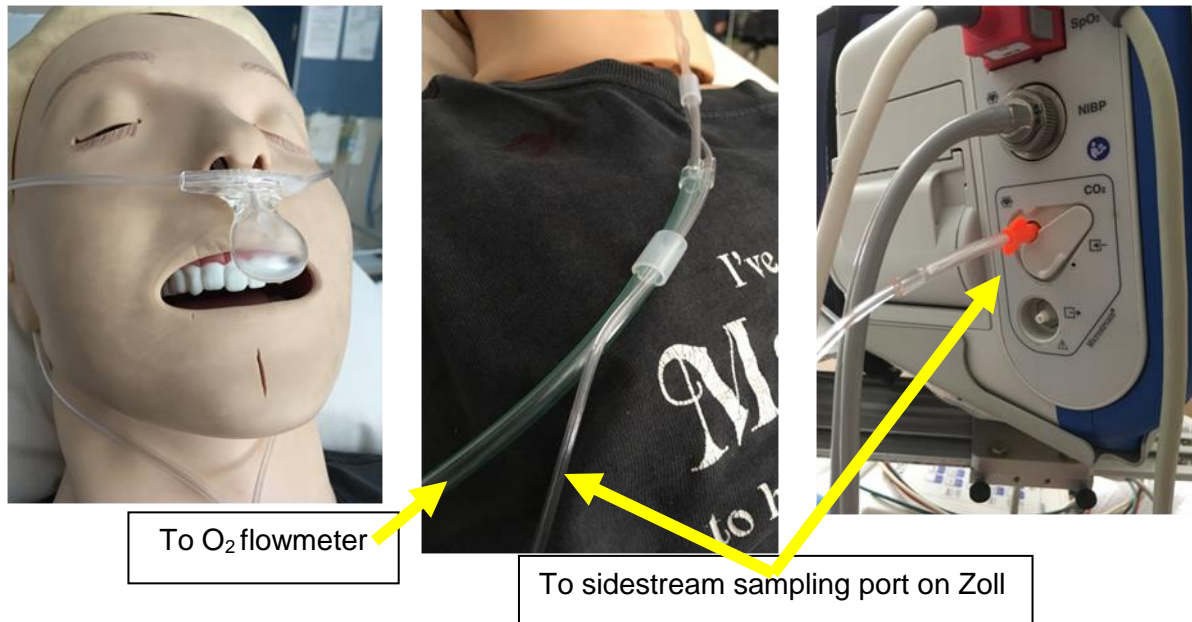


Figure 7.10. Smart CapnoLine® Plus O₂ for ETCO₂ monitoring.

Extrapyramidal side effects

The paediatric population is far more susceptible to acute dystonias especially those naive to antipsychotics. Benztropine 0.02mg/kg (max 2mg) should be drawn up and ready for administration, this is more commonly required with haloperidol than other antipsychotics.

Dysrhythmias

Antipsychotics should not be used in patients with a history of prolonged QTc and ECG monitoring is recommended when using intravenously.

2. For rapid parenteral sedation in-flight;
 - Midazolam 0.05-0.2mg/kg (max 10mg per dose) continuous S_aO₂ monitoring is required.
 - Olanzapine 5mg (<40kg) or 10mg (>40kg)
 - Haloperidol 0.1-0.2mg/kg (max 5mg per dose and max 0.5mg/kg daily) continuous ECG monitoring is required.
 - Anaesthetic agents such as propofol (1-3mg IVI followed by infusion 1-3mg/kg/hr) or ketamine (4mg/kg IMI or 0.5-1mg/kg IVI) should be considered absolute last resort for use on doctor accompanied flights with appropriate levels of monitoring and in fasted patients.
3. The doctor on board the flight and clinical coordinator should ensure an appropriate accepting emergency department for medical clearance prior transfer to Bentley Hospital, Adolescent unit.

References

1. Royal Children's Hospital Clinical Practice Guidelines. Emergency Restraint and Sedation – Code Grey. [Internet: last updated October 2012; cited 13/05/2013]. Available from: <http://www.rch.org.au/clinicalguide/index.cfm>
2. East London NHS Foundation Trust CAMHS. Guidelines for the Management of acutely disturbed children and adolescents in psychiatric settings (aged 6-17years). August 2012.
3. Psychotropic Therapeutic Guidelines Version 7. In eTG complete. Therapeutic Guidelines Ltd; 2013 July.
4. Monash Health. Acute Behavioural Disturbance Clinical Guideline. 1/9/2016.

8 MISCELLANEOUS

8.1 Anaphylaxis

Theory

1. Anaphylaxis is defined as a serious allergic or hypersensitivity reaction that is rapid in onset and may cause death.
2. The clinical presentation is an acute onset of illness (minutes to hours) including some of the following features ^(1,2):
 - *Cutaneous/mucosal*: generalized hives, pruritis or flushing, swollen lips tongue uvula, periorbital oedema, conjunctival oedema, skin symptoms are present in 90% of cases of anaphylaxis;
 - *Cardiovascular*: hypotension, syncope, tachycardia, dizziness, incontinence;
 - *Respiratory*: dyspnoea, bronchospasm / wheeze, stridor, reduced PEFr, hypoxia, nasal congestion, voice change, sensation of choking;
 - *Gastro-intestinal*: abdominal cramps, nausea, vomiting, diarrhoea;
 - *Exposure to known allergen and hypotension*:
 - greater than 30% reduction systolic BP,
 - <90mmHg adult or child over 11,
 - <(70mmHg + [2xage]) age 1-10;
 - <70mmHg 1 month to 1yr
3. Death can occur within minutes. In one study of fatalities from anaphylaxis the median time from onset of symptoms to cardiopulmonary arrest was 5 minutes for iatrogenic cases, 15 minutes for insect venom induced and 30 minutes for food induced ⁽³⁾.

Pre-flight and In-flight Management

1. Anticipate. Always question carefully about allergies before administering any drugs and exercise extra caution in known atopic individuals (asthma, hay fever, eczema).
2. Consider anaphylaxis as the diagnosis whilst actively excluding out other causes for the patient's signs and symptoms (e.g. vasovagal or hysterical reaction, asthma remembering asthmatics also suffer anaphylaxis, pulmonary embolism, hypovolaemia, hypoglycaemia).

IM Adrenaline is the initial treatment of choice for severe allergic reactions, which can be repeated after 5 minutes if no improvement.

- The dose is 0.5mg IMI in adults, and child >12 years (0.5mL of 1:1,000).
 - Child 6-12 years, 0.3mg (0.3mL of 1:1000),
 - Child <6 years 0.15mg (0.15mL of 1:1000)
 - In severe shock, or if IM injection has been ineffective, adrenaline may be administered by titrated infusion. (Drug Infusion Guideline 1. Adrenaline.)
3. Remove allergen.
 - Delay further absorption. Stop IV blood or drugs if suspected as cause.
 4. Assess the airway and breathing.
 - Be prepared for airway obstruction.

- If airway obstruction with stridor give adrenaline IMI as above then adrenaline 5mL 1:1000 nebulised.
 - Give Oxygen, assist ventilation if necessary.
 - Treat bronchospasm with adrenaline IMI as above.
 - Follow this with salbutamol 5mg nebulised every 15 minutes.
 - Consider other treatment modalities, e.g. further adrenaline, IV salbutamol.
5. Assess circulation.
 - If no pulse, CPR and adrenaline IVI bolus as above.
 - If cardiovascular collapse consider slow IVI bolus of 50 to 100 µg adrenaline (adult).
 - Fluid bolus 1 litre adult, 20mL/kg child of crystalloid.
 6. Monitor response, especially heart rate and blood pressure (good index of response to treatment).
 7. Consider other drugs to counteract histamine release and inflammatory response (however none shown to reduce mortality) e.g.
 - Steroids: hydrocortisone 4mg/kg (up to 200mg) IVI, 6 hourly or dexamethasone 0.1 - 0.25mg/kg (up to 8mg IMI or IVI).
 - Antihistamine.
 - Glucagon (especially for patients on β blockers who may be resistant to adrenaline treatment, paed 25mcg/kg) 1mg IVI every 5 mins, max 5mg.
 8. Document on an Incident Report to permit follow up of blood cross-match, medical records, and for patient advice and Medic Alert warning.

Medical Chest Items

Adrenaline ampoules 1:1,000, 1mL (Item 99)

Promethazine mixture 5mg/5mL (Item 119)

Loratadine tablets 10mg (Item 157)

Salbutamol Aerosol Spray 100µg/dose (Item 107)

Aerosol Spacer (Item 229)

Prednisolone tabs 5mg (Item 151)

Oxygen (where available).

Special notes

Hereditary Angioedema, C1 esterase deficiency and ACE inhibitor induced angioedema may share some features including airway compromise. The above treatments are ineffective for these conditions. There is however an effective treatment available in the form of ICATIBANT, a Bradykinin B2 receptor antagonist. Patients known to have these conditions may carry their own or have some stocked at their local hospital along with a protocol for administration. RFDS do not currently stock icatibant, however it might possibly be sourced from a base or tertiary hospital. The adult dose is 30mg SC to abdomen. Cost > \$5000.

References

1. Sampson HA, Munoz-Furlong A, Campbell RL, et al. Second symposium on the definition and management of anaphylaxis: summary report—Second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. *J Allergy Clin Immunol* 2006; 117:391
2. Sampson HA, Munoz-Furlong A, Bock SA, et al. Symposium on the definition and management of anaphylaxis: summary report. *J Allergy Clin Immunol* 2005; 115:584
3. Pumphrey RS. Lessons for management of anaphylaxis from a study of fatal reactions. *Clin Exp Allergy* 2000; 30:1144

8.2 Hyperkalaemia

Theory

1. Hyperkalaemia is a potentially life threatening emergency, and may result in cardiac arrhythmias and cardiac arrest.
2. Hyperkalaemia is defined as a serum potassium > 5.0mmol/L.
3. Causes include:
 - Pseudohyperkalaemia (haemolysed specimen, very high WCC)
 - Transcellular shift (acidosis, insulin deficiency, digoxin overdose, suxamethonium)
 - Tissue damage (multi-trauma, burns, rhabdomyolysis)
 - Decreased excretion (renal failure, Addison's disease)
 - Drugs (indomethacin, spironolactone, ACEI)
4. Clinical features include arrhythmias, paraesthesiae and muscle weakness.
5. ECG features include tented T waves, flattened P waves, prolonged PR interval, bradycardia, widened QRS and AV block.

Pre-flight and In-flight Management

1. Stabilise the cardiac membrane 30 min (in metabolic acidosis):
 - 10mL (0.5mL/kg in children, to max 10mL) of 10% calcium gluconate IV over 2-3 minutes. Repeat if ECG changes do not improve significantly. Avoid in digoxin toxicity.
2. Shift K⁺ into cells:
 - 10 units (0.1U/kg in children, to max 10units) actrapid insulin IV, plus either 50mL 50% glucose IV over 5 minutes, OR 250mL (5mL/kg in children) 10% glucose IV over 15 minutes. Repeat if necessary.
 - 10-20mg (2.5-5mg in children) salbutamol via nebuliser, if required in addition to insulin/dextrose therapy.
3. Correct volume depletion.
4. Treat underlying cause.
5. In severe metabolic acidosis, consider sodium bicarbonate 50-100mmol IV over 30 mins.

Special Notes

1. Patients in renal failure need close attention to hydration status. Transfer for emergency dialysis may be required for persisting hyperkalaemia.
2. Do not use salbutamol as a monotherapy – it may be ineffective in up to 40% of patients
3. Measure BSL every 30mins in patients treated with IV insulin. Hypoglycaemia should be treated with an IV bolus of glucose.
4. Avoid insulin in patients with primary adrenal insufficiency. Intravenous hydrocortisone should be administered for corticosteroid replacement.
5. Oral and rectal resonium A 15-30g 6 hourly will reduce serum K⁺ in less acute cases.

Medical Chest Items

Salbutamol aerosol spray 100µg (item 107).

References

1. Bersten A, Soni N. Oh's Intensive Care Manual. 6th ed. Butterworth Heinemann. 2009.
2. Dunn R, Dilley S, Brookes J, et al. The Emergency Medicine Manual. 5th ed. Tennyson, South Australia: Venom Publishing. 2010.
3. Hyperkalaemia [amended 2015 Jun]. In: eTG complete [Internet]. Melbourne: Therapeutic Guidelines Limited; 2014 Mar. [cited 2017, Jan 24]
4. Mount D. Hyperkalaemia. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA: 2017 [cited 2017, Jan 24.]
5. Treatment of Acute Hyperkalaemia in Adults
6. Royal Children's Hospital, Melbourne, Australia, Clinical Practice Guideline on Hyperkalaemia, [Internet, last updated March 2016; cited 2017, Jan 24], Available from: <http://www.rch.org.au/clinicalguide/index.cfm>
7. The Renal Association (UK). Treatment of Acute Hyperkalaemia in Adults [Internet]. UK:The Renal Association (UK); 2014 Mar [cited 2017, Jan 24]. Available from: <http://www.renal.org/guidelines/joint-guidelines/treatment-of-acute-hyperkalaemia-in-adults#sthash.GmdHI0KS.T7INJSSh.dpbs>

8.3 Hypokalaemia

Theory

1. Hypokalaemia is potentially life threatening and may result in cardiac arrhythmias and cardiac arrest.
2. Hypokalaemia is defined as a serum potassium <3.5mmol/L.
3. Causes include:
 - Transcellular shift (alkalosis, insulin, β 2 agonists)
 - Abnormal losses (GIT, renal, drugs, especially diuretics and corticosteroids)
 - Inadequate intake
 - Hyperaldosteronism
4. Clinical features include weakness, fatigue, rhabdomyolysis, ileus and cardiac arrhythmias.
5. ECG changes include peaked and prolonged P waves, prolonged PR and QT interval, T wave flattening and inversion, U waves and tachyarrhythmias.
6. May be associated with hypomagnesaemia.

Pre-flight and In-flight Management in Adults

1. IV infusion of potassium chloride either added to current IV fluid therapy (maximum 20mmol in 500mL saline), or as a dedicated potassium replacement infusion:
 - KCl 10mmol in 100mL 0.9% saline, over 60 minutes
 - Maximum rate 40mmol/hr - CVC required for rates >10mmol/hr
 - ECG monitoring is required.
2. Correct Magnesium:
 - Mg_2SO_4 10mmol over 15min then 20-60mmol/day

References

1. Bersten A, Soni N. Oh's Intensive Care Manual. 6th ed. Butterworth Heinemann. 2009.
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3. Hyperkalaemia [amended 2015 Jun]. In: eTG complete [Internet]. Melbourne: Therapeutic Guidelines Limited; 2014 Mar. [cited 2017, Jan 24]
4. Mount D. Hypokalaemia. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA: 2017 [cited 2017, Jan 24.]

8.4 Shock

Theory

1. Shock is defined as a state of inadequate tissue perfusion and oxygenation of tissues. Whilst hypotension is commonly present in shock, it is often absent early on and recognition and treatment should not be delayed in the normotensive.
2. Consider the four causes of shock.
 - *Hypovolaemia*. Causes of hypovolaemia (reduced intravascular volume), include haemorrhage (concealed or revealed), dehydration (loss of intra and extracellular fluids) due to losses or sequestration in the gut, excessive diuresis and excessive insensible losses (sweating).
 - *Distributive*. Causes of reduced vascular tone include peripheral vasodilatation as occurs with septic shock, anaphylaxis, drugs, and autonomic neuropathy or spinal cord injury.
 - *Cardiogenic (pump failure)*. Causes of reduced cardiac output include cardiac failure secondary to arrhythmias, myocardial infarction, valvular disease, or cardiomyopathies.
 - *Obstructive*. Massive pulmonary embolism, cardiac tamponade, venacaval obstruction due to abdominal masses (e.g. gravid uterus) or raised intra-thoracic pressure (eg. tension pneumothorax, high PEEP or breath stacking in ventilated patients).

Pre-flight and In-flight Management

1. Distinguish between patients who can be stabilised locally and those who cannot. (Dependant on pathology and local clinical skill mix and infrastructure).
2. If unable to stabilise and manage locally assign a Priority 1 or 2 doctor-accompanied flight.
3. Attend to priorities of:
 - Airway – patent and secure
 - Breathing – Adequate gas exchange
 - Circulation – 2 wide bore peripheral cannulae or intra-osseous needles. Fluid boluses of normal saline 500mL-1000mL (10-20mL/kg in children).
4. Determine cause and exclude treatment related causes of hypotension such as vasodilating drugs (GTN, salbutamol, anaesthetic agents, narcotics, antihypertensives).
5. Hypovolaemia. Replace fluids.
6. Haemorrhagic: Control haemorrhage. Note resuscitation priorities change to C-ABC with controlling compressible sources of blood loss initial priority.
 - Replace loss with blood product. (See [Major Haemorrhage](#)).
 - Prevent lethal triad of hypothermia, acidosis and coagulopathy.
 - Target MAP of 65mmHg.
7. Distributive:
 - Anaphylaxis. (See [Anaphylaxis](#)).
 - Septic shock. (See [Severe Sepsis](#)).
 - Spinal. Fluids +/- vassopressors. (See [Acute Spinal Cord Injuries](#)).
 - Adrenal crisis. Give hydrocortisone 100mg IVI.

8. Cardiogenic: Manage arrhythmias eg. Cardioversion, pacing. (See [Cardiac Arrhythmias](#)).
 Consider inotropes, chronotropes.
9. Obstructive: Left lateral position if >20 weeks gestation.
 Decompress tension pneumothorax (finger thoracostomy or needle).
 Drain pericardial effusion.
 Check for autoPEEP and breathstacking in ventilated patients, disconnect
 from ventilator, remove PEEP, reduce tidal volume, increase expiratory
 time. Ensure stomach decompressed in infants and small children.
 Consider thrombolysis if massive pulmonary embolism thought to be cause.

Medical Chest Items

Adrenaline ampoules 1: 1000, 1mL (Item 99).

References

1. Bersten A, Soni N. Oh's Intensive Care Manual. 6th ed. Butterworth Heinemann. 2009.
2. Gaieski D, Parsons P, Evaluation of and initial approach to the adult patient with
 undifferentiated hypotension and shock, 2016
3. Gaieski D, Parsons P, Definition, classification, etiology and pathophysiology of shock in
 adults, 2016

8.5 Vascular Catastrophes

Theory

Ruptured abdominal aortic aneurysm (AAA)

1. Mortality 65-85%, 50% before reaching the operating theatre, making for precarious long distance aeromedical transfers.
2. Ruptured AAA heralded by triad of sudden onset mid-abdominal, flank or back pain (+/- scrotal radiation), shock and presence of pulsatile mass.
3. Degree of shock determined by location and size of rupture. A biphasic response may occur with an initial tear into retroperitoneal space followed by larger rupture hours later.
4. Emergency ultrasound 97% sensitive in diagnosis of AAA.

Aortic dissection

1. Most common aortic catastrophe: 2-3 x more common than ruptured AAA.
2. Associated with high mortality; particularly where diagnosis/transfer delayed.
3. Diagnosis can be difficult; estimated 38% of acute aortic dissections missed on initial evaluation. Risk factors are; hypertension, trauma, connective tissue disorder (Marfan's, Ehlers-Danlos, Turner's), bicuspid aortic valve, coarctation of aorta.
4. Consideration dissection with any combination of:
 - Abrupt onset of severe thoracic or abdominal pain with sharp, tearing +/- ripping character.
 - End organ malperfusion (syncope, CVA, paraplegia, limb ischaemia, mesenteric ischaemia).
 - Mediastinal +/- or aortic widening on CXR.
 - Variation in pulse (absence of proximal extremity or carotid pulse) +/- or BP (>20mmHg difference between right and left upper limbs).
 - Aortic incompetence.
 - Cardiac tamponade.
5. Caution should be exercised with anticoagulation / thrombolysis if aortic dissection forms part of the differential diagnosis for presentations of atypical ischaemic chest pain.

Pre-flight and In-flight Management

General Principles

1. Priority 1, doctor accompanied.
2. Minimise investigations and procedures at referring hospital. Patient needs definitive vascular/cardiothoracic management.
3. Large bore IV access, monitoring (invasive blood pressure useful but should not delay transfer), indwelling catheter.
4. Consider need for blood products and reversal of anticoagulation.
5. Avoid hypothermia.
6. Aim for a quick airport handover (including an escort from the referring doctor).

Ruptured AAA

1. Avoid excessive fluid resuscitation (risk of loss of tamponade, stable retroperitoneal haematoma becoming free intraperitoneal haemorrhage).
2. Aim for systolic blood pressure 90-100mmHg with normal mental state.
3. Adequate pain control.

Aortic Dissection

1. Strict control of blood pressure and heart rate essential to reduce shear stress on arterial wall (decreases propagation, tamponade rupture):
 - Adequate analgesia – IV morphine
 - β blocker – metoprolol 2.5-5mg IV boluses, or esmolol 0.5-1mg IV boluses; calcium channel blocker if β blocker contraindicated. Avoid vasodilators such as hydralazine as they increase aortic wall stress.
 - Nitroprusside infusion 2nd line. Difficulties with delivery (light sensitive) and availability, use only after adequate β blockade to avoid reflex tachycardia.
2. Aims: HR 60-80, SBP 100-120mmHg or lowest BP commensurate with vital organ perfusion.
3. Pericardiocentesis for tamponade may make things worse.

References

1. Sakalihan N, Limet R, Defwe O. Abdominal Aortic Aneurysm. *Lancet*.2005; vol 365, issue 9470,1577-1589.
2. Hagan P, Nienaber C, Isselbacher E, et al. The International Registry of Acute Aortic Dissection: New insights into an old disease. *JAMA* 2000; 283:p897-903
3. Isselbacher E, Cigarroa J, Eagle K. Cardiac tamponade complicating proximal aortic dissection. Is pericardiocentesis harmful? *Circulation*. 1994;90:2375-2378. Black J, Mohler E, Management of acute aortic dissection, Uptodate Jan 09, 2017
4. Manning W, Aldea G, Overview of acute aortic syndromes, Uptodate Sep 29, 2016
5. Jim J, Mills J, Management of symptomatic and ruptured abdominal aortic aneurysm, Uptodate Jul 09, 2015

8.6 Mass Casualty Incidents

Theory

1. A Mass Casualty Incident (MCI) is defined as a situation where the event overwhelms the available resources. Sometimes it is immediately obvious that a disaster has occurred, but sometimes it only becomes apparent as further information comes in. Once a MCI has been declared, the methodology defined here comes into place, and this supersedes our usual RFDS mode of operation until the disaster has been completely dealt with.
2. The RFDS is an essential component of the overall Health Response to MCI in regional and remote WA. The Major Incident Medical Management and Support course (MIMMS) is used as a basis for planning, training and response to MCI's in WA. The Emergency Management Act 2005 provides for the prompt and co-ordinated organisation of emergency management in the State. The RFDS and ambulance services are support agencies to the Department of Health.

RFDS Response

1. The following information should be read in conjunction with the RFDS [Mass Casualty Incident Plan](#).
2. The primary role of the RFDS is to provide prompt advanced medical support at the scene or casualty clearing post (CCP) (this may be the nearest hospital), and collect accurate intelligence from the scene to provide back to the SHICC. RFDS MIMMS trained personnel will be assigned specific tasks to assist with command, control and communication. These roles may be on scene (Bronze level), at a command post or CCP (Silver level), or within the RFDS Co-ordination Centre or SHICC (Gold level).
3. RFDS will be tasked with co-ordinating transport of casualties by aeromedical assets.
4. ***RFDS Medical and Nursing staff first on scene of a MCI MUST NOT involve themselves with treatment or transport of casualties until a complete scene assessment and triage has been completed. This information must be recorded and relayed to SHICC (via RFDS SHICC Liaison Doctor or Clinical Co-ordinator).***
5. All RFDS teams arriving on scene must report to the Health Commander for briefing, checking safety equipment and allocation of duties, upon completion of task report back for re-tasking. RFDS staff should not agree to tasks requested by other agencies without consent of their Health Commander.
6. The structure used for defining roles, priorities and chain of command is summarized as CSCATTT as follows.

Table 8.1. Mass Casualty Incident Chain of Command

<p style="text-align: center;">C (Command & Control)</p>	<p>Command is vertical, know where you are in the health chain of command, to whom you report and who is reporting to you.</p> <p>Control is horizontal across agencies and in most instances will be held by the Police. Requests for resources or assistance from other agencies should be sent up your chain of command to the Health Commander who will liaise with Commanders from other agencies. Failure to adhere to these lines of communication will result in chaos.</p> <p>Command may occur at three levels:</p>
<p>Bronze: Ambulance forward Commander and ambulance teams (<i>RFDS forward team*</i> may be assigned to AFC to assist, must report to AFC on entry and egress)</p>	<p>Bronze at the incident site. Usually this will be managed by ambulance services.</p>
<p>Silver:</p> <p>Incident control centre (ICC) manned by:</p> <ul style="list-style-type: none"> • Police Command. • Ambulance Commander (AC) and Health Commander (HC)* (either WACHS or 1st RFDS Dr on scene depending on experience and MIMMS training. • Ambulance Loading Officer reports to AC. • HC reports to SHICC and stays on site. Not involved in patient treatment. • Fire Command. <p>Casualty Clearing Post (CCP) manned by:</p> <ul style="list-style-type: none"> • Senior Doctor* (RFDS or WACHS), ideally not involved in patient treatment rather supervision and resourcing of teams, and patient flow. • Casualty Clearing Officer (ambulance). • Triage nurse.* • Treating doctor/nurse teams.* 	<p>Silver usually in close proximity to incident site however may utilize local nursing post or hospital, location where commanders and CCP will be set up. Access controlled by police. This is the usual level at which our staff will work, we are responsible for forwarding intelligence to Gold level command.</p>
<p>Gold: State Health Incident Control Centre (SHICC), may or may not be convened at Royal St depending on nature of incident. RFDS should send liaison doctor* (usually Director of Medical Services or his delegate), works with duty RFDS Clinical Co-Ordinator* to ensure patients transported to destinations determined by SHICC.</p>	<p>Gold at an administrative level remote from the location e.g. SHICC (e.g. State Health Incident Control Centre set up in Health Dept). Allocation of patients to various hospitals occurs at this level, there is no direct referral of patients by treating doctors to receiving hospitals.</p>

Table 8.1 Mass Casualty Incident Chain of Command (cont'd)

S (Safety)	Ensure safety of self, scene and survivors. The police will determine if the scene is safe to enter and may delegate scene safety to another agency, e.g. DFES. Admission to scenes may be declined if not appropriately clad (See PPE).
C (Communication)	Determine how communication will occur and check the devices to be used (e.g. mobile phone, satellite phone, UHF radio). Do you know how to use your equipment, do you have back up power sources, do you know your call sign? Is RAVEN to be deployed?
A (Assessment)	This is a process of gathering information and determining what resources will be required to tackle the problem. See ETHANE report. Work with AC in determining suitable location for CCP.
T (Triage)	Triage will occur at many levels but it is important to use a consistent approach. The first level of triage (sieve) is to determine a priority for moving patients from the scene to a casualty clearing post. On arrival at a casualty clearing post the next level of triage (sort) determines a priority for treatment (See triage notes).
T (Treatment)	Treatment is generally confined to that essential to enable safe transport to a receiving hospital (clearly long transport times dictate more comprehensive treatment).
T (Transport)	A further element of triage occurs in determining order and mode of transport. Ensure that the right patient gets to the right place in the right time. Where patients go is determined by SHICC.

1. There is a structure for conveying information upwards to senior command and downwards when briefing staff, this is known as the ETHANE or METHANE report.
 - **M** Major incident (may be declared, on standby, or stood down).
 - **E** Exact location of incident (this may be of vital importance in the event that someone is reporting an incident in a primary location), GPS co-ordinates, nearest intersection, nearest airfield etc.
 - **T** Type of incident (e.g. bus roll over, passenger train derailment).
 - **H** Hazards present (fire, chemical, weather, traffic etc.).
 - **A** Access to the site (how should emergency services get there).
 - **N** Number and type of casualties.
 - **E** Emergency services present and resources required.
2. When RFDS staff are tasked to a mass casualty incident, they will be given an **action card** outlining their individual role and to whom they report. Potential roles are marked above with *.
3. It is expected that RFDS staff will be attired in appropriate Personal Protective Equipment (PPE) for the task they are to undertake. This will include high visibility tabard identifying their role and agency. Hat (if necessary hard hat), sunscreen / insect repellent, long

sleeved shirt, trousers with pockets and knee pads, glasses. Protective gloves may also be required on occasion.

4. St John Ambulance have mass casualty kits that may be loaded onto aircraft and transported to scene, these generally have equipment to triage and provide basic treatment to 20 casualties.
5. Given the remoteness of potential locations for mass casualty events there may be much less man power than is typically described in the medical management of such incidents, this will mean that RFDS staff may have to take on more than one role.
6. Once a major incident has been declared by SHICC, the principal communication platform used by all agencies is the WEB EOC (<https://myeoc.health.gov.au>). Login name and passwords are issued by the DPMU policy officer, Gary Shearer (08 9222 2428).

Log in with your name and password and navigate to the relevant incident.

7. Keep your mobile phone switched on, but avoid all unnecessary calls to the coordination centre and SHICC.

Triage

In a mass casualty incident the aim is to do the most for the most, this will involve a departure from usual modes of operation. Two triage tools have been designed to ensure a consistent and reproducible approach.

Triage Sieve

This prioritises patients for removal from the scene based on mobility then breathing and circulation. This may be performed by ambulance staff plus or minus a forward medical team. It is vital that a record is kept of numbers of patients triaged and what category, this should be fed back to any forward command and medical command to ensure appropriate resources assigned.

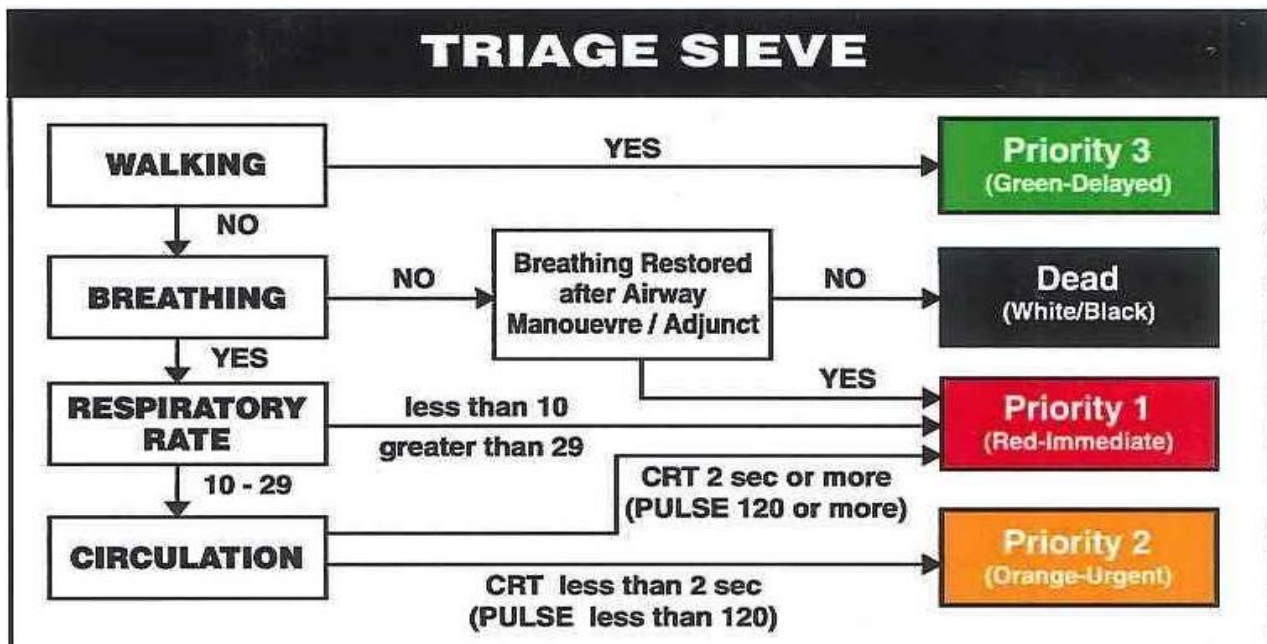


Figure 8.1. Triage Sieve

Triage Sort

This prioritises patients for treatment, this triage occurs on entry to the Casualty Clearing Post and is based on physiological parameters and a scoring system.

GLASGOW COMA SCORE		TRIAGE REVISED TRAUMA SCORE	
EYE OPENING	Score	GLASGOW COMA SCORE	Coded Value
Spontaneous	4	13 - 15	4
To voice	3	9 - 12	3
To pain	2	6 - 8	2
None	1	4 - 5	1
		3	0
VERBAL RESPONSE	Score	RESPIRATORY RATE	
Oriented	5	10- 29	4
Confused	4	greater than 29	3
Inappropriate words	3	6 - 9	2
Incomprehensible sounds	2	1 - 5	1
None	1	0	0
MOTOR RESPONSE	Score	SYSTOLIC BLOOD PRESSURE	
Obeys commands	6	greater than 89	4
Localises to pain	5	76 - 89	3
Withdraws to pain	4	50 - 75	2
Flexes to pain	3	1 - 49	1
Extends to pain	2	0	0
None	1	PRIORITY	SCORE
		IMMEDIATE	1 - 10
		URGENT	11
		DELAYED	12
		EXPECTANT	1 - 3

Figure 8.2. Triage Sort

A “SMART TAG” triage and tracking system was introduced into WA early 2012, and is the standard identification system used by the receiving hospitals, SJA and ourselves. Stocks are held at each base. The barcode system is not yet in use.

Patient Flow

The ideal flow of patients from an incident site is represented below.

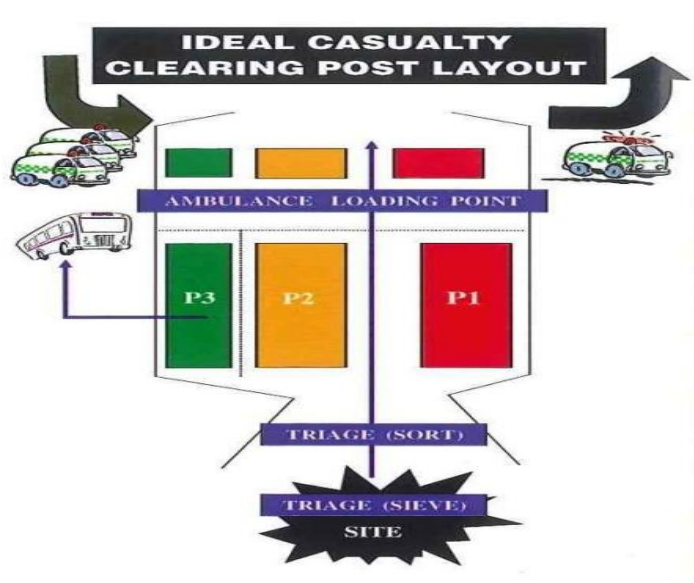


Figure 8.3. Patient Flow

Reference

- Advanced Life Support Group. *Major Incident Medical Management and Support*. 3rd Ed, 2011. BMJ Publishing.

8.7 Morbid Obesity

Theory

1. Morbidly obese patients pose a challenge in aeromedical transport. The increased size of patients is often more relevant than their weight.
2. Clinical considerations in transport are particularly related to:
 - respiratory function (hypoventilation and respiratory failure, particularly when supine);
 - airway and ventilation (difficulty with intubation and mechanical ventilation);
 - underlying cardiovascular disease (exacerbated by hypoxia and hypercapnia);
 - difficulty with procedures (vascular access, urinary catheterization, splinting);
 - difficult patient examination and clinical assessment; and
 - general patient handling in flight.
3. Operational considerations include stretcher dimensions, transferring patients between stretchers and vehicles, safe restraint, loading and unloading procedures, aircraft weight & balance, emergency egress, and range & payload restrictions.
4. AFTS stretchers (as used in the PC-12) are certified to carry an occupant of any weight once secured in the aircraft, however for ground handling (pushing around with legs extended) a safe maximum of 180kg is recommended. The AFTS or Barker SLD (Stretcher Loading Device) is certified to a safe working load of 160kg - 180kg patient weight (subject to model), however heavier patients can be lifted if manual-lifting assistance is provided. The most common issue is whether the patient will fit on the stretcher rather than weight.
5. The LifePort stretchers (found in the Rio Tinto LifeFlight Hawker 800XP jet) are certified for an occupant of any weight, but limited in practice to patients of 130kg maximum due to stretcher dimensions and loading considerations.
6. St John Ambulance Ferno 50-E stretchers (fluoro yellow undercarriage) have a 230kg patient safe working load and 56cm width. Some older Ferno 50 stretchers found in country ambulances have a SWL of 159kg. A special Complex Patient Transport Vehicle (CPTV) is available in Perth and able to transfer patients up to 500kg.
7. The RFDS Bariatric Transport System (BTS) can be retrofitted to any PC-12 in the fleet. It enables a patient of up to 285kg in weight and potentially 100cm in width or 200cm in length, to be loaded into our aircraft and safely restrained in flight.
8. In addition to clinical management decisions, the critical decisions to be made by retrieval doctors are:

Whether the patient is suitable for RFDS air transport at all (road retrieval in the CPTV should be considered for patients within 200-300km of Perth, with or without an RFDS team); and if the patient can be managed on an AFTS stretcher, or needs the BTS.

Pre-flight Assessment

1. Obtain all clinical details relevant to the underlying referral for transport. Determine if aeromedical transport is necessary in accordance with established preflight assessment guidelines.
2. Obtain an accurate patient weight. Where possible, patients should be weighed. If not possible, determine how the estimated weight was derived and seek supporting evidence. The best estimate of weight is usually provided by asking the patient. Alternatively, estimations based on arm circumference and height can be calculated.

Women (kg) = (2.15 x arm circumference in cm) - 64.6 + (0.54 x height in cm)

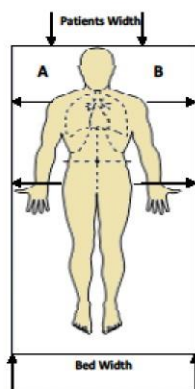
Men (kg) = (3.29 x arm circumference in cm) - 93.2 + (0.43 x height in cm)

- Obtain an assessment of the patient's size and decide whether they can be carried on an AFTS stretcher.

Did they come in by ambulance? If the patient fits on a St John Ferno 50 stretcher, they should fit a standard RFDS stretcher.

Patient width can be obtained by measuring the bed width, then subtracting the distance from bed edge to iliac crests or hips or shoulders, on each side. (Measuring across the abdomen is inaccurate).

- Obtain photos by SMS or email, to assist you in making a decision.



Measure the bed width.

Measure the bed-edge to shoulder and bed-edge to iliac crest or hip distance on each side.

Subtract these (A+B) from the bed width.

If the largest patient dimension is > 68cm then transfer on a standard Ferno or AFTS stretcher will be unlikely.

Figure 8.4. Obese Patient Measurement

- As a guide, consider the BTS for patients over 150kg in weight, where it is reported that the patient is very large, or they exceed the dimensions above. For borderline cases, there are operational impacts to consider, including:
 - delays to install the BTS;
 - inability to carry a second patient; and
 - inability to divert a crew already in flight.
- Make a clear decision and inform the Coordination Centre whether a standard aircraft is suitable, or the BTS is required. Negotiate any operational issues.
- Confirm if there is a need for the retrieval team to go in to the hospital, or the patient can be brought to the airport by ambulance. Brief the flight nurse and pilot if there are queries.
- If there are any clinical, operational or equipment issues, contact the Director of Medical Service (DMS) or delegate for guidance. Patients are not to be declined transport based on their size or weight. Delays or resource issues may require escalation to involve Regional Medical Directors or the State's Chief Medical Officer, through the DMS.
- Morbidly obese patients will usually be doctor-accompanied, to manage the underlying medical problems and to ensure a two-person clinical team to physically handle the patient. The priority must be based on the underlying diagnosis not availability of resources.

Flight Management

- If a standard aircraft is to be used, request additional persons to assist with loading and unloading at the pickup airport. If additional personnel are required to assist with unloading, provide early notification to the Coordination Centre staff so these can be arranged well in advance. In Perth, the CPTV should be requested to attend.

Bariatric Transport System

1. Operation of the Bariatric Transport System is outlined elsewhere in detailed training materials. If the BTS is to be used, the aircraft will need to be configured by the pilot, which may take an hour. Assistance should be offered to the pilot to help expedite the process. Removal of items of medical equipment by clinical staff, such as the scoop stretcher, in accordance with a published list, is also required to reduce weight.
2. The BTS comprises five key elements: the bariatric stretcher, the aircraft bariatric stretcher restraint brackets, the bariatric loading platform and restraint bracket, the mobile bariatric lifting pedestal and the Hovermatt blower with disposable mat.
3. The pilot, retrieval doctor and flight nurse will travel in to the referring location, with the BTS system, to bring the patient out on the bariatric stretcher. The RFDS pilot is trained and responsible for the safe loading and restraint of the bariatric stretcher in both the aircraft and ambulance.
4. The ambulance should be sent out empty, without a standard stretcher, so that the BTS stretcher can be installed. Laminated instructions on use of the system and a copy of the Australian Standard Testing Certificate are included with the equipment, to allay any concerns by ambulance officers regarding use in road vehicles. The system is only compatible with Ferno equipped Mercedes Sprinter ambulances.
5. In the referring health service, clinical staff will oversee patient assessment, 'packaging' for transport and using the Hovermatt for transfer onto the bariatric stretcher. The disposable Hovermatt is left in place under the patient to assist with unloading and handling in Perth.
6. Use the knee-lift and the restraint net to assist with comfortably restraining large bodies.

Induction of anaesthesia

1. Invest in good preparation. Be prepared for potential difficult airway. Position the patient in a 'ramped' position (external auditory meatus in line with angle of sternum). This may require a number of pillows under shoulders, head and neck.
2. Adequate pre-oxygenation (consider using PEEP valve on BVM).
3. Use rapid sequence induction, be prepared for risk of aspiration (suction on and enough people to turn patient if necessary). Give gastric acid prophylaxis if time permits.
4. Ventilate with PEEP and 45° head up. Tidal volume is based on ideal body weight. Titrate the ventilator pressures. Transport ventilators may struggle with large patients and hand ventilation may be required.
5. Monitor ABGs.
6. Beware of sensitivity to opiates and sedatives.
7. Anticipate a reduction in cardiac performance (prepare with fluids and or inotropes).
8. Critically ill morbidly obese patients need adequate nutrition - ensure early dextrose +/- insulin.

References

1. Adams, JP. Murphy, PG. Obesity in anaesthesia and intensive care. *BJA*, 2000, Vol.85 No.1 91-108.
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3. RFDS Western Operations. Bariatric Training Manual & eLearning package (2014)
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8.8 Acute Pain Management

Theory

The goal of acute pain management is to balance reduction of distress due to pain, with safe transport. Inadequate analgesia can lead to increased oxygen demand, myocardial strain and raised intracranial pressure amongst other issues.

The accurate assessment of the cause of pain, initial stabilisation including immobilisation, titration of analgesia, monitoring for side effects including excess sedation are necessary.

The medications involve using simple analgesics, through to opiates and appropriate use of local anaesthetic techniques.

Pre-flight and In-flight Management

1. Referring hospital to initiate management of primary pathology and analgesia. Appropriate advice should be given to primary locations.
2. Paracetamol (15mg/kg) doses, six hourly, maximum of 1g per dose, orally or intravenously. Modify dose for liver disease. Be aware Paracetamol syrup is available in 120mg/5mLs and 240mg/5mLs, the latter in the medical chest. It is also available in suppository form.
3. Non steroidal anti-inflammatory drugs (NSAIDs), given orally with food or a proton pump inhibitor:

Ibuprofen - 10mg/kg up to 400mg PO eight hourly. Contraindications include renal impairment, gastric ulcer disease, bleeding and pregnancy. It may worsen asthma/COPD in a few susceptible patients.

Ketorolac - 0.05mg/kg IV or IM, up to 10mg.

4. Opiates are used for severe pain. Monitor respiratory rate and sedation level. Modify doses for renal and liver failure. Titrate to effect. Topical opiates such as a buprenorphine or fentanyl patch have a limited role in acute pain management; and can be potent particularly in the opiate naive patient.

Morphine: 0.1mg/kg IV, IM or SC in divided doses

Oral preparations 0.25mg/kg PO, divided into 5 doses.

Fentanyl: 1mcg/kg IV in divided doses

1.5mcg/kg intranasal, as an initial dose followed by 0.75mcg/kg if required (max dose 50mcg + 50mcg). If further doses are needed consider alternate route. Contraindications include decreased level of consciousness, epistaxis.

Oxycodone: 0.25mg/kg PO, divided into 5 doses. Oxycontin SR may be used at the same time.

Intravenous morphine levels have a peak effect up to 20 minutes after injection, while fentanyl is faster in action. Immediate release oral opiates take about an hour for peak effect.

The oral route is preferred if this is an option, while IV preferable to IM, due to absorption issue and the need to avoid sharps in flight.

A disposable "GO Medical®" patient controlled analgesia set may come out with the patient. This can be continued provided the patient has ongoing monitoring. It contains a 0.5mL injection port which fills up every 5minutes. The reservoir will contain the opiate solution. Avoid using additional opiates via other routes. Ensure the lines are left connected and are intact.

Antiemetics are often required, options include:

Metoclopramide: 0.2mg/kg IV, IM, PO up to 20mg 8 hourly.

Ondansetron: 0.1mg/kg IV, Buccal up to 8mg, 8 hourly.

Droperidol: 0.01mg/kg IV up to 0.5mg, 8 hourly

Prochlorperazine: 12.5mg IV, IM, PO 8 hourly

Medications for motion sickness including hyoscine should be considered

7. Ketamine is used for analgesia as well as sedation in some situations. Problems include dissociation, nausea and salivation. It has a lower but not insignificant risk of sedation and respiratory depression.

Bolus doses of 0.3mg/kg (divided into 3 doses), to a total maximum of 45mg, given 10 minutes apart. Infusions of 0.1-0.2mg/kg/hour maybe considered. The same monitoring as intravenous opiates is required.

8. Local anaesthesia may provide pain relief of four to eight hours depending on the block. The referring hospitals may institute pre-flight. Relative contraindications include neurovascular compromise and risks of compartment syndrome.

Lower limb blockade is the most useful in transport. Femoral, fascia iliaca or sciatic nerve blocks can be performed either using landmark based techniques or ultrasound guided techniques. Ropivacaine (2.5mg/kg), or Bupivacaine (2.5mg/kg) should be used. Total local anaesthetic doses should be noted.

Maximal doses:

Bupivacaine: 2.5mg/kg (35mL of 0.5% solution in a 70kg adult)

Ropivacaine: 2.5mg/kg (85mL of 0.2% solution in a 70kg adult)

Lignocaine: 4-5mg/kg (28-35mL of 1% solution in a 70kg adult)

Upper limb blockade is unlikely to be beneficial in transport, and requires considerable time and expertise.

Spinal and epidural techniques have limited use in transport though staff should be aware of side effects and complications.

Patients may present with epidurals insitu, particularly post caesarean. The disposable "GO Medical®" patient controlled epidural anaesthesia set is likely to come with the patient. This can be continued provided the patient has ongoing monitoring (haemodynamics and lower limb sensation and motor review).

It has a 4mL injection port which fills up every 15minutes. The reservoir contains the solution (may be local anaesthetic or narcotic). Avoid using additional opiates via other routes if there is opiate within the epidural. Ensure the lines are left connected and are intact. The use should be ceased if there are concerns regarding haemorrhage, high block, respiratory depression or hypotension. If a decision is made to cease its use, it should be left intact and handed over to the receiving hospital for removal at an appropriate time.

Intercostal blocks for the treatment of ribs fractures can be useful. Be mindful of potential for causing pneumothorax.

9. Antineuropathic medications – May be used for acute pain, with a starting dose of gabapentin of 150-300mg and pregabalin of 75mg. This is used as an adjunct rather than replacement. Side effects include sedation and respiratory depression.

May be useful with:

Rib fractures, crush injuries, de-nervation, and burns

Obstructive sleep apnoea, chronic opiate and pain management problems such as those on long term opiates, respiratory disease and neuromuscular disease.

10. In patients with chronic opiate use (including methadone, oral buprenorphine programs) advice should be sought from their pain specialist or usual carer if possible.

Maximise non-pharmacological and non-opiate therapies. Continue regular medications. There is likely to be a higher need for opiates with these patients.

Special Notes

Compartment syndrome - Pain disproportionate to injury or escalating analgesia requirements should alert to the possibility of this surgical emergency.

Obstructive Sleep Apnoea (OSA) – Patients with OSA are more sensitive to opiates, with an added likelihood of obstruction of the upper airway. Maximise non-opiate analgesia and slowly titrate opiates. When titrating opiates, 1/3 of the normal dose should be a starting point.

Age variations – Both extremes of ages are more susceptible to the adverse effects of analgesia. However they are often also limited in their ability to verbalise their distress. Monitor closely and use age appropriate paediatric pain charts.

Methoxyflurane (Penthrane) is often used in the prehospital setting. It is a volatile agent delivered by inhalation. Concerns regarding delayed hepatic and renal toxicity have limited its ongoing use. Doses in adults of less than 6mLs (1.5g) are thought to be safe. Other adverse effects include sedation and drowsiness.

Medical Chest Items

Paracetamol (171,178,192), Panadiene Forte (173), Ibuprofen (189), Morphine (188)

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8.9 Diving Related Injury and Illness

Theory

1. There are a number of coastal locations in Western Australia where diving is a popular past-time, in addition some locations have industry dependant on diving. In particular Ningaloo Reef, Broome and some isolated pearl farms in the Kimberley, Busselton / Dunsborough, Esperance, Geraldton.
2. Fiona Stanley Hospital Hyperbaric Medicine Unit (HMU) is the state referral centre for diving emergencies. The Unit treats approximately 30 – 60 cases of Decompression Illness (DCI) per year, many of which occur outside the metropolitan area.
3. Fiona Stanley Hospital HMU is the only reliable emergency recompression facility available in Western Australia. A chamber is situated in Broome, however this is primarily for use by the pearling industry.
4. A diving history is important even if the patient is being transported for an unrelated problem as this will determine the flight profile required. Any symptoms developing within 24 hours of a dive should be considered as diving related if no other clear plausible cause is identified.
5. The diver may suffer from illness related to dysbarism, the general aquatic environment, or non dive related medical conditions.

Barotrauma

Barotrauma is an injury caused by a change a pressure change affecting a volume of gas (Boyle's law). Barotrauma of descent ("squeeze") commonly involves the middle ear causing pain and injury to the tympanic membrane. Other common injuries include sinus squeeze and mask squeeze. Difficulty equalising can also lead to inner ear barotrauma where rupture of the round or oval window with perilymph leakage results in acute dizziness, nausea and hearing loss

Barotrauma of ascent primarily affects the lungs as a result of breath holding or air trapping. This pulmonary barotrauma may result in mediastinal emphysema (presenting as hoarseness, neck swelling, retrosternal pain), pneumothorax / tension pneumothorax or arterial gas embolism (AGE).

Decompression illness (DCI)

Decompression illness is caused by intravascular or extravascular bubbles that are formed as a result of reduction in environmental pressure (decompression). The term covers both AGE, in which alveolar gas or venous gas emboli (via cardiac shunts or via pulmonary vessels) are introduced into the arterial circulation, and decompression sickness (DCS), which is caused by in-situ bubble formation from dissolved inert gas. Both syndromes can occur in divers, compressed air workers, aviators, and astronauts, but arterial gas embolism also arises from iatrogenic causes unrelated to decompression.¹

Decompression Sickness (DCS)

DCS is a disease caused by primarily by bubbles formed from dissolved gas in blood and/or tissue following a reduction in ambient pressure (Henry's law).

Bubbles can have mechanical, embolic and biochemical effects caused by activation of the complement, kinin and coagulation cascades. DCS can occur even if a diver has been diving well within the limitation of their dive tables, predisposing factors include exercise, dehydration, hypothermia, age, alcohol, repetitive dives, multiple ascents, altitude exposure and obesity.²

Clinical manifestations include skin rashes (right to left shunts e.g. PFO), joint pain, localized swelling through to neurological (spinal cord and central including altered mental state and ataxia), cardiac and pulmonary. Symptoms usually occur within 6 hours.

Arterial gas embolism (AGE), cerebral arterial gas embolism.(CAGE)

In this scenario pulmonary barotrauma or cardiac/pulmonary shunts are the origin of gas bubbles entering the circulation. With CAGE due to pulmonary barotrauma symptoms occur almost immediately the diver surfaces resulting in loss of consciousness, fitting, chest pain and cardiovascular collapse. The sooner the onset of symptoms the greater severity. Abnormal gas pressures.

This includes nitrogen narcosis, hypoxia, hypercapnoea all of which resulting reduced mental performance and put the diver at risk of unsafe diving and drowning. Shallow water blackout is a hypoxic phenomenon that also occurs in snorklers (the diver hyperventilates to blow off CO₂ and increase their breath hold time but may become apnoeic as a result).

Points to note in dive history

1. Maximum depth of dive, and duration of dive
2. Diving equipment and gas mixture used.
3. Diving site and weather conditions.
4. Any difficulty whilst diving, notably RAPID ASCENT.
5. Use of computer, computer warnings messages (computer should accompany diver to HMU).
6. Episodes of returning to surface (bounce diving).
7. Decompression stops, safety stops, time and depth.
8. Other dives within 24 hours, and surface intervals.
9. Exercise, alcohol use and air travel pre/post dive.
10. Past history of DCI.

The aquatic environment

Issues to consider are near-drowning and envenomation.

Pre-flight and In-flight Management

1. The priority and need for doctor will depend very much on the nature of the presentation.
2. All patients who have a history of diving in the last 24 hours should be transported with a sea-level cabin even if their presentation is unrelated.
3. A strict sea-level cabin should be requested. Any meets must also occur at sea-level locations. An exception may include CAGE injuries from close locations like Rottneest, where low level helicopter may offer an advantage reducing time to recompression therapy, discussion with the Hyperbaric Medicine Unit is advised.
4. A patient with suspected CAGE must be kept flat at all times to avoid bubbles rising up to the cerebral circulation.
5. High flow oxygen must be given, if necessary the demand regulator on the aircraft can provide 100% oxygen with a good seal and divers are familiar with breathing via a regulator.
6. IV rehydration with normal saline will assist with tissue perfusion. Maintain a urine output of 2mL/kg/hr. A urinary catheter is advisable for the more severely affected.
7. Ensure normothermia and normoglycaemia.
8. Administration of NSAIDS may be helpful (not aspirin).

9. If pulmonary barotraumas is suspected a pneumothorax should be considered. Bedside ultrasound is preferable to CXR.
10. The definitive treatment is recompression which involves transfer to a recompression chamber. The dive profile/ computer/ dive history may be useful in planning recompression therapy.
11. A severe diving injury in the Kimberley may ultimately need transfer to Perth but it is worthwhile exploring the possibility of an initial recompression in the Broome chamber prior transfer.

Useful numbers

FSH HMU

Normal working hours tel: 08 6152 5222,

Out of hours tel: 08 6152 2222 and request the hyperbaric medicine Doctor on call.

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8.10 Epistaxis

Theory

Epistaxis is a common, but potentially life threatening condition. The frequency of epistaxis increases with age (with a concurrent increase in anticoagulant and antiplatelet agent use).

Pre-flight management

1. Clot evacuation and bi-digital pressure.
 - Position the patient upright to prevent reflux of blood into the pharynx and airway.
 - Suction out significant clot or ask the patient to blow their nose and ask the patient to apply pressure by pinching the nasal alae firmly against the anterior septum.
 - Maintain this position until bleeding ceases (for at least 10 to 15 minutes), release if it produces posterior bleeding.
 - Gain IV access, monitor the patient and be prepared to manage the airway if required.
 - Give supplemental oxygen via mouth if dyspnoea or hypoxia are present.
 - Consider reversal of anticoagulation with Prothrombinex if significant haemorrhage present in a warfarinised patient. (See [Reversal of Anticoagulation](#)).
2. Topical local treatment.
 - Spray with a topical local anaesthetic and vasoconstrictor agent (such as cophenylcaine).
 - As an alternative soak gauze in undiluted IV solution 1g tranexamic acid and apply to the anterior septum with pressure(6).
3. Tamponade
 - If bi-digital pressure and topical agents have not been sufficient to cease bleeding proceed to a tamponade procedure.
 - If available insert a rapid rhino balloon device in the affected nostril after first soaking the outer gauze in water for 1 minute. Inflate the balloon with saline or sterile water, posterior first then anterior until bleeding ceases.
 - Inflation may be painful and opiate analgesia is likely to be required.
 - If bleeding fails to cease, consider also tamponading the contralateral nostril.
 - If no rapid rhino device is available consider using a foley catheter or packing the nose with ribbon gauze (soaked in tranexamic acid).
4. Monitor and transfer
 - Transfer the patient in a position that best maintains airway patency.
 - Give supplemental oxygen via face mask if required (avoid using nasal cannulae post epistaxis).
 - Transport to a destination with adequate facilities to manage further bleeding.

Technique for foley catheter insertion for posterior epistaxis(7)

If a balloon tamponade device is not available, posterior tamponade can be achieved by insertion of a 10 to 14 French Foley catheter using the following approach:

- Position the patient properly and pretreat with a topical anesthetic and vasoconstrictor.
- Before insertion, coat the catheter with a suitable, petroleum-free lubricant and trim the tip of the catheter to minimize irritation of the posterior structures.
- Advance the catheter along the floor of the nose until it is visible in the posterior oropharynx.
- Partially fill the balloon with 5 to 7mL of sterile water.
- Retract the catheter gently until it lodges against the posterior choana in the nasopharynx.
- Complete the filling of the balloon by adding another 5mL of sterile water. Pain or distention of the soft palate suggests overfilling.
- Clamp the catheter in place with an umbilical clamp or small c-clamp, as from a nasogastric tube. Place padding between the clamp and the alae to prevent excessive pressure, which otherwise can lead to necrosis.

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9 NEUROLOGICAL

9.1 Status Epilepticus

Theory

1. Status epilepticus is a clinical or electrical seizure lasting longer than 5-10 minutes, or a series of seizures without complete recovery over the same period of time. After 30 minutes, the brain begins to suffer from hypoxia and acidosis, with depletion of local energy stores, cerebral oedema, and structural damage. Eventually, pyrexia, hypotension, respiratory depression, and even death may occur.
2. There can be a variety of causes of status epilepticus. Common causes include anticonvulsant withdrawal, alcohol withdrawal, cerebro-vascular accident, metabolic derangement (hypoxia, hyponatremia [$<120\text{mmol/L}$] hypoglycaemia, hyperosmolality [$>300\text{mosm/L}$]), trauma, drug toxicity (amphetamines, cocaine, salicylates, methanol, ethanol), CNS infection, hyperthermia ($>41\text{-}42^{\circ}\text{C}$) or tumour.
3. Search carefully for seizure activity in the comatose patient. Manifestations may be subtle, eg, deviation of head or eyes, repetitive jerking of fingers, hands, or one side of the face.

Pre-flight and In-flight Management

Flights for patients with status epilepticus will usually be doctor-accompanied and priority 1 or 2, depending on the facilities of the referring location.

1. Protect the Airway:
 - Roll the patient onto one side if possible. Endo-tracheal intubation may be necessary. Do not insert objects through clenched teeth, as it will not protect the airway and may cause broken teeth.
2. Obtain IV access:
 - If possible, take bloods for FBC, glucose, electrolytes, magnesium, and calcium determinations; hepatic and renal function tests; as well as extra tubes of blood for possible toxicology screen or drug levels (including anticonvulsants if patient is known or suspected to be taking them).
3. If IV access cannot be obtained:
 - diazepam may be given rectally at a dose of 0.5mg/kg (maximum 20mg) or
 - midazolam can be given intranasally at a dose of 0.2mg/kg (max dose 10mg) or
 - midazolam can be given IM at a dose of 0.2mg/kg (max dose 10mg).
4. Rule out hypoglycaemia:
 - Give glucose, 50mL of 50% solution IV over 5 minutes **or** 2.5mL/kg of 10% dextrose for children.
 - If malnutrition or alcohol withdrawal is suspected, give thiamine, 100mg IV slowly prior to, or at the same time as glucose.
5. Give midazolam (preferable) or diazepam:
 - Midazolam IVI loading dose is $5 - 10\text{mg}$ (paediatrics 0.2mg/kg), followed by $0.05\text{-}0.2\text{mg/kg/hr}$.

OR

 - Diazepam IVI $5\text{-}10\text{mg}$ (paediatrics 0.25mg/kg) IV over 1-2 minutes.
 - Watch for apnoea, bradycardia, or hypotension.

6. Administer a loading dose of phenytoin or levetiracetam - regardless of the effect of diazepam, a maintenance drug is required:
 - Give phenytoin in normal saline, 15-20mg/kg by IV infusion at a rate of 50mg/min (paediatrics 2mg/kg/min) or slower.OR
 - If giving levetiracetam, 40mg/kg (max 3g) in normal saline over 5min.
 - Infusion of phenytoin at more rapid rates (especially if given into centrally placed IV lines) can precipitate cardiac arrhythmias or hypotension.
 - Phenytoin orally or IV should be given to all patients except those who have a short-term metabolic condition known to cause seizures, such as alcohol withdrawal, hypoglycaemia, which does not require or respond to phenytoin. Phenytoin should not be given to those with seizures due to sodium channel blocker toxicity.
 - Phenobarbitone is the drug of choice for neonates. Give 20mg/kg in normal saline over 15min.
7. If these measures fail, general anaesthesia with ventilatory assistance and neuromuscular junction blockade will most likely be required. Use a rapid sequence induction technique with cricoid pressure, thiopentone (3 - 5mg/kg) and suxamethonium (1.5mg/kg).
8. Measure arterial blood gases and pH:
 - Arterial blood PCO₂ is a sensitive indicator of the adequacy of ventilation (hypercapnia is present in proportion to the degree of hypoventilation). Metabolic acidosis due to lactic acidosis resulting from status epilepticus is commonly present for as long as 1 hour after a seizure, depending on the duration and vigour of muscular activity. This acidosis requires no treatment. Acidosis lasting longer than 1 hour should prompt a search for other causes of acidosis.

Special Notes

- Consider Meningitis:

Commence appropriate antibiotics if meningitis is suspected, especially if fever (body temperature > 38.5°C) or nuchal rigidity is present. However, the muscle activity of status epilepticus alone produces transient fever higher than 38.5°C in 25% of patients. Status epilepticus may also produce a mild transient cerebrospinal fluid pleocytosis (>100 cells/micro/L).
- Prevent injury to the patient during the seizure by padding the environment. Do not use rigid restraint (fractures may result) or insert objects into the patient's mouth during the seizure.

Medical Chest Items

Diazepam ampoules 10mg/2mL (Item 98), Diazepam tablets 2mg (Item 191).

STATUS EPILEPTICUS FLOW CHART

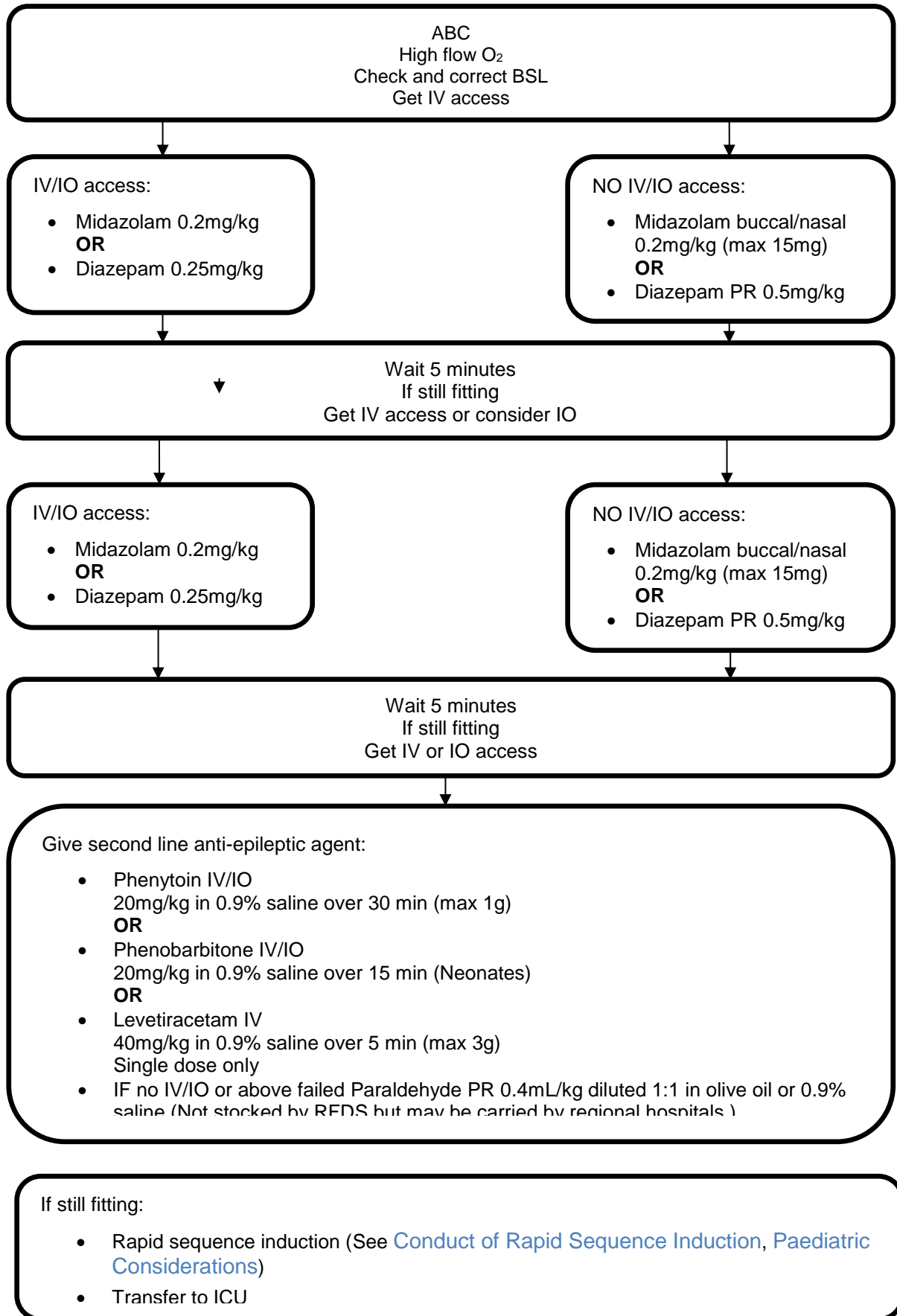


Figure 9.1. Status Epilepticus Flow Chart

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9.2 Subarachnoid Haemorrhage

Theory

1. Defined as bleeding into the subarachnoid space. Seventy percent are due to rupture of an aneurysm in the Circle of Willis. Other causes are arterio-venous malformations, mycotic aneurysms, illicit drug use, bleeding diatheses and trauma. Risk factors include smoking, hypertension, alcohol, genetic factors, sympathomimetic drugs, anti-thrombotic therapy.
2. Up to 50% of patients have a small “warning bleed” which precedes the major bleed. From the major bleeds, 50% of patients will die or be permanently incapacitated. A further 30% will die if not treated.
3. Important clinical symptoms and signs include: sudden onset of severe “worst ever” headache, vomiting, transient loss of consciousness, depressed conscious state, meningism and hypertension. Seizures occur in <10% but focal neurological signs are uncommon. Diagnosis is confirmed by CT scan (95% sensitive) and/or lumbar puncture.
4. Early neurosurgical or radiological intervention and the use of nimodipine (a calcium channel blocker which reduces vasospasm in cerebral arteries) give excellent outcomes for patients with warning bleeds and less severe SAH.

Pre-flight and In-flight Management

1. The priority assigned will be determined by the severity of the patient’s illness and accuracy of diagnosis, confirmed wherever possible with CT scan. Most flights will be Priority 2. Some critically ill patients in smaller centres may be Priority 1.
2. Flights should be doctor-accompanied if there is a significantly depressed conscious state, seizures or severe hypertension. Many patients with these criteria will benefit from early intubation and IPPV.
3. All patients should receive oxygen and be fully monitored. An IDC may be appropriate for very drowsy patients. Where possible, patients should be nursed with 30° head elevation to reduce cerebral oedema. Actions that induce sudden rises in intracranial pressure (e.g. coughing on ETT, vomiting or seizures) should be avoided as much as possible. Prophylactic anti-emetics and anticonvulsants may be appropriate for individual patients.
4. Moderate rises in blood pressure are necessary to maintain cerebral perfusion pressure, and do not require treatment. Severe hypertension should be treated initially with sedation and analgesia. If blood pressure remains grossly elevated, control with IV atenolol 1mg/min or metoprolol (until target blood pressure reached). Do not correct rapidly. In patients with severe hypertension, invasive arterial pressure monitoring is helpful.
5. Nimodipine is used to prevent secondary cerebral vasospasm but is not stocked by RFDS and is generally only available in tertiary settings.

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9.3 Alcohol Withdrawal

Theory

1. 50% of persons with alcohol-use disorders have symptoms of alcohol withdrawal when reducing alcohol consumption; 3-5 % of these people have Grand Mal convulsions and/or delirium.
2. Stages of alcohol withdrawal:
 - MILD ALCOHOL WITHDRAWAL
 - a. Usually within 6-24 hours of cessation of drinking.
 - b. Usually resolves in 2-3 days without treatment but can last for 10 days.
 - c. Symptoms include; insomnia, tremulousness, mild anxiety, GI upset, anorexia, headache, diaphoresis, palpitations (autonomic hyperactivity) and hyperreflexia.
 - WITHDRAWAL SEIZURES –
 - a. Usually 12-48 hours after last drink but can occur within as little as 2 hours.
 - b. Singular or brief flurry of tonic-clonic convulsions over a short period. Recurrent or prolonged seizures and status epilepticus are not consistent with withdrawal seizures and should be further investigated.
 - c. Usually occur after long history of chronic alcoholism.
 - d. Left untreated it will progress to delirium tremens in a 1/3 of patients.
 - e. Benzodiazepines are used and Phenytoin is ineffective.
 - f. With a history of withdrawal seizures early treatment with diazepam is indicated (diazepam loading or 40mg on day one).
 - g. Prophylactic treatment with Carbamazepine and Sodium Valproate has no benefit in preventing alcohol withdrawal seizures.
 - ALCOHOL HALLUCINOSIS –
 - a. Up to 25 % in people with prolonged alcohol abuse.
 - b. It is NOT the same as delirium tremens. It
 - c. Develops 12-24 hours post abstinence and resolve within 24-48 hours (earliest point where delirium tremens begin).
 - d. Usually visual hallucinations and patients are very distressed because there is no global clouding of sensorium (delirium).
 - e. First drug of choice in treatment is Diazepam. Add Olanzapine if not responding to diazepam alone.
 - DELIRIUM TREMENS – (See [Delirium Tremens](#))
3. The AWS (alcohol withdrawal scale) is commonly used to dose and administer benzodiazepines for management of alcohol withdrawal. The AWS is not a diagnostic tool and not useful in differentiating between delirium tremens and delirium due to medical illness.

Pre-flight Management

1. Consider the potential for any patient to be withdrawing from alcohol. If possible, attempt to obtain an AWS score (especially the trend) and treatment needed so far from the referring location.
2. Symptom-triggered sedation
 - Mild withdrawal (AWS <4) - assess every 4-6 hours and give 5 – 10mg Diazepam orally
 - Moderate withdrawal (AWS 5-14) - assess every hour and give 10-20mg oral Diazepam (might need IV as absorption might be compromised and patient need to be NPO). Repeat diazepam 10mg every hour until AWS < 4. Might need up to 80mg of Diazepam. With moderate withdrawal a doctor needs to evaluate the patient and if more than 80mg is needed.
 - Severe withdrawal (AWS >14) – assess every 10-15 minutes – give an initial dose of 10 - 20mg Diazepam IVI and repeated every 5-10 minutes until appropriate level of sedation achieved. (RASS 0 to -2 or AWS <14).

Table 9.1. Alcohol Withdrawal Scale

Symptom / Sign	Score	
Perspiration	No abnormal sweating	0
	Moist skin	1
	Localised beads of sweat	2
	Whole body wet from perspiration	3
	Maximal sweating – clothes and linen wet	4
Tremor	No tremor	0
	Slight intention tremor	1
	Constant tremor of arms	2
	Constant marked tremor of extremities	3
Anxiety	No apprehension	0
	Slight apprehension	1
	Understandable fear – eg of withdrawal	2
	Anxiety occasionally rising to panic	3
	Constant panic-like anxiety	4
Agitation	Rests normally	0
	Cannot sit or lie still / insomnia	1
	Moves constantly, wants to get out of bed	2
	Constantly restless, gets out of bed	3
	Maximally restless	4
Hallucinations	No evidence of hallucinations	0
	Distortion of real objects with awareness that these are not real	1
	Appearance of totally new objects or perceptions with awareness that these are not real	2
	Believes the hallucinations are real but still oriented to place / person	3
	Believes him/herself to be in a totally non-existent environment; preoccupied and cannot be diverted or reassured	4
Axilla temp	<37.1°C	0
	37.1-37.5°C	1
	37.6-38.0°C	2
	38.1-38.5°C	3
	>38.5°C	4
Orientation	Oriented to time/place/person	0
	Oriented to person, unsure of place / time	1
	Oriented to person, disorientated to place / time	2
	Disoriented with short periods of lucidity	3
	Completely disoriented	4

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9.4 Delirium Tremens

Theory

1. Occurs 48-72 hours after last drink and can last 1-5 days.
2. Lifetime risk of developing in chronic alcoholics is 5-10%
3. 5% of patients undergoing alcohol withdrawal suffer from delirium tremens.
4. There is are always symptoms of withdrawal prior to onset.
5. Characterized by the following in the clinical setting of acute reduction in alcohol intake:
 - a. Profound alteration of sensorium including disorientation, agitation and hallucinations with rapid-onset fluctuating disturbance of attention and cognition
 - b. Severe autonomic hyperactivity – Tachycardia, hypertension, tachypnoea , hyperthermia and diaphoresis
 - c. Associated with fluid and electrolyte abnormalities – hypovolemia, hypokalemia, hypomagnesemia, hypophosphatemia, increased O₂ consumption, raised pH (decreased cerebral blood flow)
6. Predictors of severe alcohol withdrawal syndrome:
 - Past history of severe withdrawal
 - AWS score > 14 especially in association with systolic BP >150mmHg or pulse rate >100 beats per minute
 - Recent withdrawal seizures(20% of patient)
 - Older age – usually over 30
 - Recent misuse of other depressant agents
 - Concomitant medical problems – cardiac, respiratory and gastrointestinal disease
 - Hypokalemia
 - Thrombocytopenia
 - History of daily heavy and prolonged alcohol consumption
 - Presence of significant withdrawal in the presence of an elevated alcohol level
 - Longer period since last drink – patients who presents with withdrawal more than 2 days after their last drink are more likely to experience DT's than those who present within 2 days
7. Mortality 5%. This is usually due to arrhythmia, fluid/electrolyte imbalance, complicating illness like pneumonia, occult trauma, hepatitis, pancreatitis, alcoholic ketoacidosis or Wernicke-Korsakoff syndrome.(3) Older age, pre-existing cardio-pulmonary disease, core temp >40°C and co-existing liver disease are associated with a greater risk of mortality.

Pre-flight and In-flight Management

1. Priority will vary depending on severity of illness, local resources and skill mix. A doctor-accompanied flight may be necessary if the patient is severely ill or if symptoms are difficult to control.
2. Management
 - 1) Rule out alternative diagnoses and treat
 - 2) Symptom control:

- a) Benzodiazepines to control psychomotor agitation and prevent progression to more severe withdrawal. Benzodiazepines have a protective benefit against alcohol withdrawal in particular to seizure. The doses needed to control agitation and insomnia vary among patients and can be prodigious (>2000mg of diazepam in first 2 days in some patients). Care should thus be taken with protecting a patient's airway.
- 3) Supportive care – calm, quiet environment, reassurance, ongoing assessment with AWS scale, attention to fluid and electrolyte deficits and treat as needed, prevent hypoglycaemia, prevent aspiration.
- 4) Thiamine
 - a) 100-250mg IVI daily. For prevention of Wernicke encephalopathy (confusion, ataxia and ophthalmoplegia) and Wernicke-Korsakoff syndrome or Thiamine-related cardiomyopathies (temporary alcohol related compromised cardiac function.
 - b) Prolonged glucose administration without thiamine supplementation is a risk factor for development/worsening of Wernicke encephalopathy. Give Thiamine before giving glucose, but do not delay giving glucose if a patient is hypoglycaemic.
- 5) Magnesium
- 6) In patients with severe alcohol withdrawal including those who require intubation and ventilation the AWS cannot be used effectively. Here the RASS [See [Richmond Agitation-Sedation Scale \(RASS\)](#)] score will be more appropriate. Aim for a score of 0 to -2.

Medical Chest Items

Diazepam inj 10mg/2mL (Item 98), Diazepam tablets 2mg (Item 191).

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11. Sarai M, Tejani AM, Chan AH, Kuo IF, Li J. Magnesium for alcohol withdrawal [internet]. Cochrane database of systematic review 2013 9[cited 2017 Feb 17], Issue 6. Art. No.: CD008358. DOI: 10.1002/14651858.CD008358.pub2.

9.5 Stroke Pathway and Endovascular Clot Retrieval for Acute Ischaemic Stroke

Theory

1. Selected patients with acute stroke benefit from early referral to a specialised stroke service.
2. There is a geographic referral pathway for patients with stroke to tertiary centres. (See below.)
3. Prompt discussion with a duty stroke consultant will identify patients eligible for time critical interventions such as Endovascular Clot Retrieval (ECR) or thrombolysis.
4. ECR is currently available at Sir Charles Gairdner Hospital (SCGH) 24 hours a day and Fiona Stanley Hospital (FSH) 8am to 5pm.
5. ECR has substantial benefits for some patients with large vessel occlusion (LVO) in particular those involving anterior circulation. LVO includes; internal carotid artery, middle cerebral artery, basilar artery.
6. A Rapid Arterial occlusion Evaluation (RACE) score is being used to identify patients pre-hospital and pre-imaging who may be candidates for ECR.

Pre-flight Management

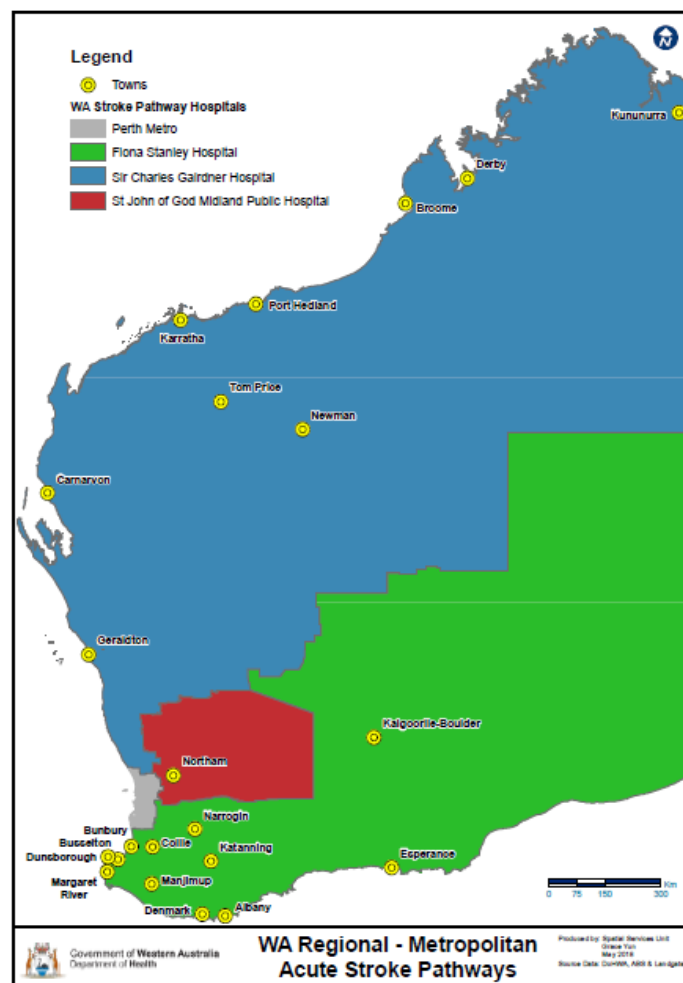






Figure 9.2. Stroke Pathways

- *Patients from Northam and Central Wheatbelt go to Midland Health Campus*
- *Patients from Kimberley, Pilbara, Midwest / Gascoyne go to SCGH*
- *Patients from South-West, Goldfields and Great Southern go to FSH.*
- *The **duty Telestroke consultant** can be reached through the relevant switch board.*

Identifying candidates for acute intervention

- This decision is made in conjunction with the duty stroke consultant.
- Patients with LVO who can be at an ECR centre ready to commence procedure within 6 hours (anterior vessel) or 12-24 hours (posterior vessel) of onset of symptoms may be candidates for thrombolysis and ECR. Note this includes time to do imaging and be reviewed by neurologist.
- A RACE score ≥ 5
- Pre-morbidly independent.
- Some patients from regional centres will have had access to appropriate imaging and review of same via PACS at the time of referral.
- WACHS sites with Emergency Telehealth Service may already have had consultation with Telestroke consultant and plan made.
- Final decision is not made until imaging and review by consultant in ECR centre.
- Suitable candidates should be prioritised P1 and generally doctor accompanied. Ambulance transfer from Jandakot should also be P1.
- Consider advantage of time saved with door to door retrieval using helicopter for locations within 150-200km radius of Perth.

Table 9.2 **R**apid **A**rterial **O**ccclusion **E**valuation (**RACE**) score.

Item	Instruction	Finding	RACE Score
Facial Palsy 	Ask patient to smile	Absent (symmetrical movement)	0
		Mild (slightly asymmetrical)	1
		Moderate to severe (completely asymmetrical)	2
Arm Motor Function 	Extend the patients arm, 90° if sitting or 45° if supine	Normal to mild (limb upheld more than 10sec)	0
		Moderate (limb upheld less than 10 sec)	1
		Severe (patient cannot raise arm against gravity)	2
Leg Motor Function 	Extend the leg of the patient 30° (in supine)	Normal to mild (limb upheld more than 5 sec)	0
		Moderate (limb upheld less than 5 sec)	1
		Severe (patient cannot raise leg against gravity)	2
Head & Gaze Deviation 	Observe eyes and head deviation to one side	Absent (eye movement to both sides possible, cephalic deviation observed)	0
		Present (eyes and cephalic deviation to one side observed)	1
Aphasia (for RIGHT sided hemiparesis only) Test: Understanding of words	Give the patient two verbal orders; "Close your eyes." "Make a fist."	Normal (performs both tasks correctly)	0
		Moderate (performs one task correctly)	1
		Severe (performs neither tasks)	2
Agnosia (for LEFT sided hemiparesis only) Test: Cognitive recognition	Ask patient: 1. "Whose arm is this?" whilst showing him/her the affected arm. (asomatognosia) 2. "Can you move your arm?" (anosognosia)	Normal (Recognises arm, and attempts movement)	0
		Moderate (No arm recognition OR is unaware of arm)	1
		Severe (Unable to recognise & unaware of arm) Both questions answered unconvincingly	2
Score total (note maximum of ≤ 9 out of 11)			/11

Reference

1. Wessledine, A. WA Health Endovascular Clot Retrieval Service Plan for Acute Ischaemic Stroke. July 2016.

10 OBSTETRIC

10.1 Pre-term Labour and Tocolysis

Theory

1. Pre-term labour is defined as onset of labour before the 37th week of gestation. For RFDS purposes the emphasis is generally on women who are less than 36 weeks gestation where adequate paediatric management is not possible outside a tertiary (King Edward Memorial or Darwin Hospital) or in some cases regional setting. (Some regional paediatricians are able to manage neonates from 34 weeks gestation).
2. With careful assessment, prompt transfer and aggressive tocolytic therapy in flight, the majority of patients in pre-term labour can be transferred to an appropriate centre where optimal conditions exist for delivery and resuscitation of the neonate.
3. The neonatal transport service (NETS) in Western Australia is not intended to be a resuscitation service and should not be tasked for alleged imminent delivery without the consultation of a senior RFDS doctor with obstetric experience.
4. There is nothing to be gained by “going in” to hospitals to retrieve women in advanced labour, a rapid airport handover should be arranged.
5. Perinatal morbidity and mortality for low and extremely low birth weight infants is significantly improved by delivery and resuscitation in a tertiary setting.
6. Tocolysis is used to suppress labour to allow administration of corticosteroids for foetal lung maturation and ensure safe transfer in-utero to an appropriate facility.
7. Corticosteroids enhance foetal lung maturation and decrease the risk of neonatal intracerebral haemorrhage and necrotizing enterocolitis.

Pre-flight and In-flight Management

1. Diagnosis of labour is based on painful regular contractions accompanied by cervical change (effacement and dilatation). Information to be sought in the pre-flight assessment includes parity, frequency and strength of contractions, cervical dilatation and effacement, status of membranes (intact or ruptured), foetal heart rate (CTG if available), presentation, past obstetric history.
2. Examination of the cervix is essential, a digital examination unless contraindicated (PV bleed, SROM without labour). If contraindicated a sterile speculum examination is requested.
3. Encourage the use of foetal fibronectin swab testing. This test must be done prior to any vaginal examination and in the absence of ruptured membranes. A negative result less than 37 weeks in otherwise low risk women with a cervical length >15mm has a 96% predictive value for no delivery in the next week. This may mean a transfer is unnecessary and the woman can be monitored locally (depending on skill and experience of local staff).
4. Cervical length as determined by transvaginal ultrasound, if available, may be useful, a cervical length >30mm and undilated internal os are negative predictors of birth.
5. If <36+6 weeks completed pregnancy give betamethasone (Celestone Chronodose) 11.4mg (equals 2 ampoules) IM. This may be contraindicated if chorioamnionitis.
6. Commence tocolysis immediately unless contraindicated. (Large APH or abruption may be a contraindication as is foetal death).
7. Instructions regarding choice of tocolytic should be clear:
 - a) <4cm with intact membranes a trial of oral nifedipine may be considered.

- The dose is 20mg PO (not slow release) at 30 minute intervals until contractions cease OR 60mg has been given.
 - Side effects of nifedipine include facial flushing, headache, nausea, tachycardia, dizziness, hypotension (very uncommon in normotensive patients), cardiac failure, raised liver enzymes.
- b) If the woman is still labouring after 90 minutes salbutamol must be commenced.
- c) 4cm commence salbutamol as per RFDS infusion guidelines:
- Side effects of salbutamol include tachycardia, hypotension, tremor, pulmonary oedema, hyperglycaemia, hypokalemia.
- d) If woman is term and the transfer time short it may be appropriate to avoid tocolysis and allow labour to progress.
- e) Rarely alternative tocolytics may be considered:
- glyceryl trinitrate – 5-10mg patch (max 20mg), may cause hypotension and headache.
 - indomethacin 100mg PO then 25mg PO 4 hourly. Risk of closure of foetal ductus arteriosus and renal impairment, gastric ulceration.
8. Magnesium for foetal neuro-protection is not routinely used in transport, the expectation is that it will be given on arrival at the tertiary centre as it is not given until 4 hours pre-delivery and then only for women less than 30 week gestation. Should a patient already have magnesium running a doctor accompanied flight will be required with cardiac, respiratory and patella reflex monitoring.
- If used, a loading dose of 4g is given over 20min followed by 1g per hour infusion for 4 hours, cease if delivery occurs earlier.
 - If delivery is considered imminent discuss use with a consultant at KEMH.
9. The patient should be nursed in the left lateral position and given supplemental oxygen to compensate for altitude hypoxia.
10. A doctor will be required for women in more advanced labour where delivery is a risk. Priority will depend on stage of labour (i.e. threatened vs. established).
11. In the presence of prolonged rupture of membranes, Group B Streptococcus or urinary tract infection antibiotics should be given, benzylpenicillin 3g IV, if allergic to penicillin clindamycin 900mg IV.
12. If delivery is not imminent at the end of transfer then it may be acceptable to cease the salbutamol for ambulance transfer. If the woman is actively progressing and requiring ongoing salbutamol infusion she should have a nurse or doctor escort to the receiving hospital.

Special Notes

1. Nifedipine is the mainstay of tocolysis in the tertiary setting and consequently erroneous advice may be given regarding its use by hospital staff inexperienced in the retrieval setting. Whilst there is evidence supporting both the efficacy of nifedipine and its reduced side effect profile, this pertains to a very different population and circumstances with different clinical goals to those that apply to RFDS air transport over long distances in Western Australia.
2. All of the trials supporting nifedipine had a cut off of 4 cm dilatation, none of them involved long distance transport of women in advanced labour.

3. There are few if any other geographical locations in the world where women are transported in labour distances of thousands of kilometres. Many years of cumulative experience with using IV salbutamol in this setting has proven to be safe and resulted in almost no risk of in-flight delivery. The advantage of using IV salbutamol by infusion is that it can be ceased, or titrated to effect.

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3. King Edward Memorial Hospital, Clinical Guidelines, 2.5 Preterm Labour, Section B. February 2011.
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10.2 Pre-Eclampsia

Theory

1. Hypertension in pregnancy is defined as SBP \geq 140mmHg, DBP \geq 90mmHg, or a rise from booking blood pressure of $>$ 30/15mmHg.
2. Pre-eclampsia is a multi-system disorder characterized by hypertension developing after 20 weeks gestation and involvement of one or more other organ systems.

Renal involvement

- Significant proteinuria – PCR $>$ 30mg/mmol or 2+ or greater on dipstick if PCR N/A
- Serum creatinine greater than or equal to 90 micromol/L
- Oliguria $<$ 80mL/4 hours

Haematological involvement

- Thrombocytopenia $<$ 100,000/ μ L
- Haemolysis, raised bilirubin, LDH $>$ 600mIU/L
- DIC

Liver involvement

- Raised transaminases
- Severe epigastric or right upper quadrant pain

Neurological involvement

- Convulsions (Eclampsia)
- Persistent visual disturbances (photopsia, scotomata, cortical blindness, posterior reversible encephalopathy syndrome, retinal vasospasm)
- Persistent, new headache
- Stroke

Pulmonary oedema

Fetal growth restriction (FGR)

3. Treatment in transport is aimed at controlling blood pressure and preventing convulsions. The definitive treatment is delivery of the foetus.
4. HELLP syndrome (Haemolysis, Elevated Liver enzymes, Low Platelet count) is a variant of severe pre-eclampsia carrying a worse prognosis and thereby requiring more urgent transfer, at least P2.

Pre-flight and In-flight Management

1. Patients with severe pre-eclampsia will require a priority 1 or 2 doctor accompanied flight. Deterioration from mild to moderate to severe may occur over hours or days, mandating frequent reassessment. Asymptomatic hypertension may be a priority 2 or 3 nurse only flight.
2. Where possible laboratory evidence of disease severity should be sought (FBC, creatinine, LDH, ALT, AST, uric acid and urine Protein Creatinine Ratio)
3. Direct questioning about symptoms should be documented (headache, epigastric or RUQ pain, visual disturbance, hyperreflexia).
4. Ensure IV cannula and oxygen.

5. The only controlled studies of bed rest for pre-eclampsia have shown no significant maternal or fetal benefit.
6. Consider antihypertensive therapy:
 - a) Mild (140-160/90-100) – No compelling evidence base for improved outcome, consult with specialist
 - b) Severe (SBP \geq 170mmHg or DBP \geq 110mmHg) – Treatment is mandatory to prevent cerebral events, although **do not drop below 140/80** (placental perfusion)
 - 1st line nifedipine 10mg PO, repeat after 30 min to max 40mg
 - 2nd line labetalol 20mg IV over 2 min, repeat after 10 min to max 80mg (risk bradycardia, contraindicated in asthma)
 - 3rd line hydralazine 5-10mg IV over 2 min, repeat after 20 min to max 30mg
 - ACEI and ARB medications are contraindicated
 - Seek advice re follow up medication after severe hypertension resolved
7. Consider anticonvulsant therapy for anyone at risk of eclampsia, i.e. prodromal symptoms consistent with severe pre-eclampsia. If possible discuss with the Obstetric consultant on duty at KEMH prior to initiating treatment
 - Magnesium sulphate seizure prophylaxis – Loading dose of 4g over 20 min followed by maintenance of 1g per hour. (See infusion guidelines 12. Magnesium sulphate infusion – Pre-eclampsia). Monitor for loss of deep tendon reflexes and bradypnoea (<12) with 15 minutely observations. Continuous cardiac monitoring and availability of calcium gluconate is required (2.2mmol in 10mL for magnesium toxicity). A magnesium infusion mandates a doctor accompanied flight as respiratory failure may occur.
8. Administer betamethasone 11.4mg IM to women 24-36+6 weeks in whom imminent delivery is anticipated.
9. Restrict IV fluids to 80mL / hr. Pulmonary oedema is a common complication. Monitor hourly urine output via urinary catheter.

References

1. King Edward Memorial Hospital, Clinical Guidelines: Hypertension in Pregnancy – Medical Management. September 2016.
2. Lowe SA et al, Management of hypertensive disorders of pregnancy. Society of Obstetric Medicine of Australia and New Zealand 2014.

10.3 Eclampsia

Theory

1. Eclampsia is a generalized tonic-clonic convulsion as a consequence of pregnancy induced hypertension or pre-eclampsia. It may occur pre, intra or post labour.
2. Eclampsia is associated with increased risk of maternal and foetal mortality and morbidity.
3. Prodromal symptoms and signs include a sharp rise in blood pressure, severe headache, drowsiness or confusion, visual disturbances, reduced urine output +/- increased proteinuria, twitchiness, upper abdominal pain, nausea or vomiting.
4. Complications include abruption, disseminated intravascular coagulation, brain haemorrhage, multiorgan failure involving cardiac renal and hepatic systems.
5. Eclamptic seizures are rarely prolonged and respond well to magnesium sulphate, there is little need for other anticonvulsants and need for intubation and ventilation is also rare.
6. Be sure to consider other causes of seizures in your differential diagnosis – most seizures in pregnancy are not eclamptic

Pre-flight and In-flight Management

1. Flights for patients with eclampsia will usually be priority 1, doctor accompanied.
2. First line seizure management:
 - Nurse left lateral position.
 - Keep airway clear, suction if necessary.
 - Apply high flow oxygen.
 - Establish IV access.
3. Anticonvulsant therapy:
 - Magnesium sulphate 4g IV over 20 min followed by maintenance infusion of 1g per hour. (See infusion guidelines).
 - If a further seizure occurs an additional 2g can be given over 5 min.
 - If no IV access available, e.g. In a primary setting, Mg₂SO₄ can be given IM, 4g each buttock.
 - As a second line IV diazepam in 2mg boluses (max 10mg) may be considered.
4. Monitor for evidence of magnesium toxicity (respiratory depression, loss of deep tendon reflexes, cardiac dysrhythmias) and have calcium gluconate available to treat.
5. Manage hypertension by parenteral means as described in guideline for severe pre-eclampsia
6. Monitor hourly urine output.
7. Expedite delivery in suitable facility.
8. Monitor for complications and where possible determine platelet count, uric acid, clotting function, renal and liver function tests.
9. In the unlikely event that a patient is intubated KEMH does not have the capacity to manage a ventilated patient, communication with receiving units is paramount. It may be that the patient should be transported to an adult intensive care facility (preferably SCGH) with a view to sending an obstetric and paediatric team there to deliver. Ensure that this is all determined before your arrival in Perth.

References

1. King Edward Memorial Hospital; Clinical Guidelines, Hypertension in Pregnancy, September 2016
2. Lowe SA et al; Management of hypertensive disorders of pregnancy. Society of Obstetric Medicine of Australia and New Zealand 2014

10.4 Antepartum Haemorrhage

Theory

1. The major causes of bleeding in the last half of pregnancy are placenta praevia, abruption, uterine scar disruption and ruptured vasa previa. Bleeding originating in the lower genital tract is also common but rarely significant.
2. **Placenta praevia** – implantation of the placenta over the lower segment of the uterus. Major implies the placenta covers partially or completely the internal os. Digital vaginal examination is contra-indicated, speculum examination is permissible. Delivery should be by caesarean section. Blood loss is generally painless and associated with a hypotonic uterus.
3. **Placental abruption** – placental separation from the uterine wall. May be significant concealed blood loss. Pain is the key in diagnosis, especially pain persisting between contractions. Consider with history of minor trauma, cocaine use, pre-eclampsia / hypertension or previous abruption. The diagnosis is largely clinical and *may be missed on ultrasound*. Tocolysis may be a relative contraindication as a contracted uterus may tamponade some blood loss. The more severe grades may be associated with coagulopathy. There is a high risk of foetal compromise.
4. **Uterine scar disruption** tends to occur in the setting of labour with sudden pain, bleeding cessation of contractions and loss of foetal heart sounds. Urgent caesarean delivery is required. Transfer may be required post operatively.
5. **Vasa praevia** is very rare and bleeding occurs with membrane rupture, blood loss is foetal with a 50% foetal mortality.
6. Blood loss <50mL is considered **minor**, 50-1000mL without shock is considered **major**, >1000mL and/or shock is considered **massive**.

Pre-flight and in-flight management

1. The priority is determined on a case by case basis but will usually be priority 1 or 2 with a midwife and doctor team for major or massive APH.
2. Provide oxygen. Left lateral position.
3. Look for evidence of shock, remember blood loss may be concealed.
4. Ensure two wide bore intravenous cannulae are inserted and at least 4 units of blood cross matched to accompany the patient. If possible arrange for full blood count and coagulation profile. Consider maternal rhesus status.
5. Assess cervix by speculum unless placenta known to be clear of the os, then digital examination appropriate.
6. Insert a urinary catheter as a measure of tissue perfusion.
7. Look for evidence of pre-eclampsia if abruption a possible diagnosis and manage accordingly. (See [Pre-Eclampsia](#)).
8. Ensure corticosteroids administered according to gestation and risk of delivery in next 24 hours.
9. Consider tocolysis if contracting, there is no contraindication with placenta praevia but relative contraindication with major abruption.
10. Enquire as to CTG result or foetal heart rate. If there is evidence of severe foetal distress delivery may need to be expedited at a regional centre then neonatal transfer arranged.
11. Enquire as to results of ultrasound examinations localising placenta and looking for evidence of abruption (remember abruption can be missed on ultrasound).

References

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2. Brown FT, Cadogan MD. Diagnosis and Management in Emergency Medicine (7th Ed). Boca Ratan: CRC Press: 2016

10.5 Post-Partum Haemorrhage

Theory

1. Occurs in 3-5% of all pregnancies, causes 5% of maternal deaths.
2. Primary vs Secondary.
 - a) Primary: $\geq 500\text{mL}$ loss within 24 hours of delivery. Causes (the 4 "T"s):
 - Tone – uterine atony (grand multi, multiple pregnancy, polyhydramnios, prolonged, precipitate or dysfunctional labour, use of tocolytics, uterine infection).
 - Tissue – retained placenta or products of conception.
 - Trauma – tears uterine, vaginal or cervical.
 - Thrombin – coagulopathy (e.g. foetal death, abruption, HELLP syndrome, pre-eclampsia, amniotic fluid embolism).
 - b) Secondary: 1-6 weeks post partum, often related to infection +/- retained products. Less likely to be catastrophic.

Pre-flight and In-flight Management

1. All flights for primary PPH will be either priority 1 or 2 and doctor accompanied.
2. Ensure as precise a diagnosis and elucidation of cause as possible so as to guide management strategy, including a thorough examination of genital tract, inspection of placenta.
3. First line therapy / resuscitation:
 - Lie patient flat, may need to raise legs.
 - High flow oxygen.
 - Two large bore IV cannulae. Fluid resuscitation is as per guidelines for shock.
 - Have blood available, preferably cross-match supplied by referring hospital, if not carry O negative to patient. Consider early use of FFP and platelets (where available). (See [Transfusion Medicine](#), [Major Haemorrhage](#)).
 - Monitor BP, HR, ECG, Urine output, Blood loss, Temp, O₂ saturation.
4. Specific management :
 - a) Tone
 - Uterine massage
 - Empty bladder
 - Oxytocics – 1st line ergometrine 0.25mg IV (with antiemetic) or syntocinon 10 units IV if hypertensive. Followed by oxytocin infusion (40 units in 1 litre CSL or N/saline over 4 hours).
2nd line prostaglandin F2 alpha (1mg/mL) 1mL intramyometrially or IM up to 5 mL.
OR
misoprostol tabs 1mg (5 x 200µg) PR.
OR
Carboprost or Prostinfenem (15-methyl-PGF₂α) 0.25mg IMI repeated 15 minutely to a maximum of 2.0mg in total. Whilst this option offers an easy route of administration it may only be available at regional hospitals so may need to be sourced from there for a flight. This is an off-label use however its use is well supported with evidence. Beware the risk of bronchospasm.

- Bimanual compression.
- Compression may also be provided by insertion and inflation of a Bakri balloon (with normal saline) +/- a B-Lynch suture.

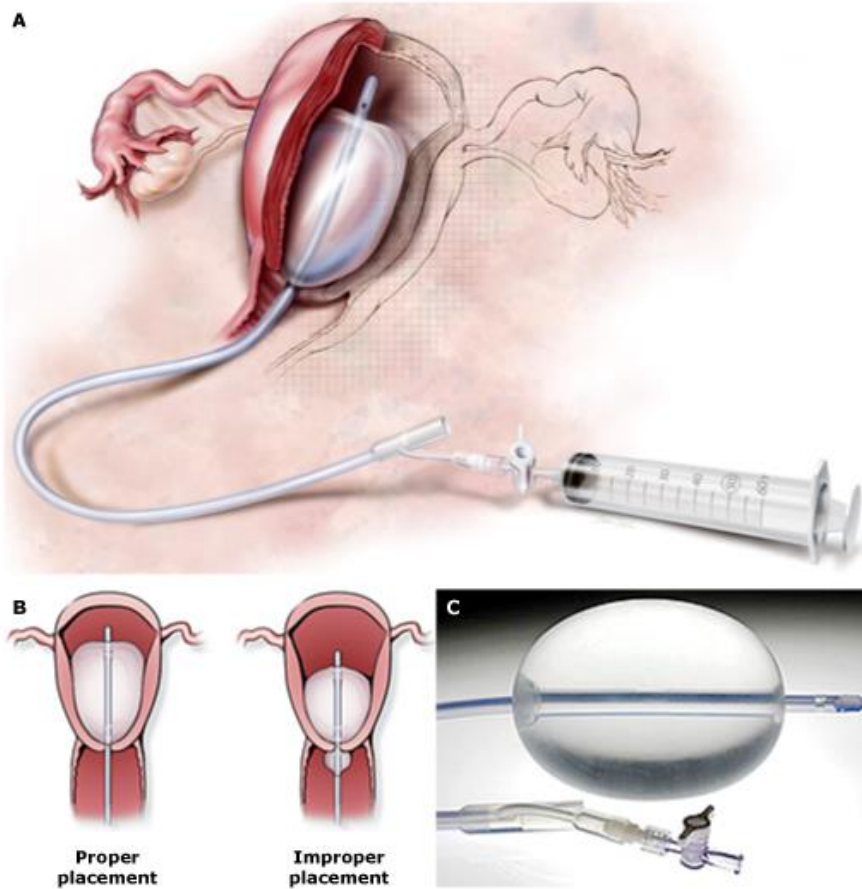


Figure 10.1. Bakri Balloon Placement

- Tissue – Ensure placenta is delivered and complete or arrange same urgently.
- Trauma – Repair or arrange urgent repair of tears. Early transfer to operating theatre may be required for ligation of major vessels or hysterectomy.
- Thrombin – Where available check coagulation studies, replace as necessary.
- Other (if stable) – Cervical and vaginal swabs for MC&S, antibiotics (amoxicillin /ampicillin 1g 8 hourly IV and metronidazole 500mg IV 8 hourly plus or minus gentamicin. Ultrasound. Analgesia may be required.

References

1. The Royal Women's Hospital, Victoria, Australia. Clinical Practice Guidelines. 2006
2. American Academy of Family Physicians. Advanced Life Support in Obstetrics. Course Syllabus. 4th ed.
3. The Royal Australian and New Zealand College of Obstetricians and Gynaecologists. Management of Post Partum Haemorrhage. C-Obs 43. Amended February 2016.

10.6 Epidurals In-Flight

Theory

1. A small number of patients each year are transported with epidural catheters in situ. It is not recommended that they be used in-flight for the following reasons:
 - Risk of movement of the catheter with patient transfer, results in the chance of intrathecal or intravascular injection.
 - Sub-optimal resuscitation conditions exist in-flight to manage a total spinal or local anaesthetic toxicity event.

Pre-flight and In-flight Management

1. An epidural may be “topped up” pre-flight by staff at the referring hospital if there is adequate time for post-top up observations.
2. If the flight is doctor accompanied and the doctor experienced in use of epidurals and confident of placement, they may give small incremental top ups.
3. IV narcotics and NSAIDS may be prescribed for flight nurse administration in the interim.

10.7 Obstetric Trauma

Theory

1. All major trauma in pregnancy should be managed with the same priorities as in the non pregnant, i.e. Airway and Cervical Spine, Breathing and Circulation. Some modifications in positioning will need to be made in the presence of a gravid uterus >20 weeks gestation. What is best for mother is best for baby.
2. Only after initial assessment and stabilisation of mother should attention be turned to the foetus.
3. The greatest risks to the foetus are from maternal hypoxia and hypovolaemia.
4. Obstetric complications that may occur in the setting of trauma include foetal injury, foeto-maternal transfusion, pre-term labour, rupture of membranes, amniotic fluid embolism, abruption and uterine rupture.
5. Anatomical and physiological changes to the airway, respiratory and circulatory systems occur in pregnancy which must be borne in mind when managing the pregnant patient.
 - Airway – laryngeal oedema, soft tissue enlargement in neck and large breasts interfering with intubation.
 - Breathing – reduced functional residual capacity due to upward pressure on diaphragm from uterus. Increased oxygen demand. More rapid onset of hypoxia after induction.
 - Circulation – Increased blood volume, heart rate and relative anaemia. Effects of aorto-caval compression in the supine position. Can lose 15-20% of blood volume before signs of hypotension and shock.
 - Gastrointestinal – gastro-oesophageal reflux and increase risk of aspiration.

Pre-flight and In-flight Management

1. Priority and need for doctor will be assessed on a case by case basis however as per our usual major trauma guidelines most of these flights will either be a priority 1 or priority 2 with a medical team (doctor and midwife).
2. Ensure airway is secure, cervical spine is splinted where necessary. Provide supplemental oxygen.
3. Ensure two wide bore cannulae are inserted and cross matched blood arranged to accompany patient where necessary.
4. Manage the mother's injuries according to usual EMST / ATLS principles.
5. Either a left lateral position or wedge under right hip to ensure left lateral tilt is required when 20 weeks gestation or greater.
6. After above priorities attended to the following obstetric considerations should be documented:
 - Fundal height
 - Uterine activity
 - CTG/FHR/FM
 - Vaginal loss blood or liquor
 - Cervical change (either speculum or digital exam)
 - Blood group, Kleihauer-Betke, coags. Anti-D if Rh negative

- Ultrasound
 - Steroids if delivery possible in next 24 hours
 - Tocolysis if indicated
7. All major trauma should be referred directly to the trauma centre (RPH). Any obstetric support will be provided by a team sent from KEMH/NETS. If there is evidence of foetal distress or imminent delivery good communication is the key, notifying trauma teams of the need for urgent obstetric intervention will ensure the most appropriate response is ready on your arrival at RPH.
8. Minor blunt abdominal trauma (no significant maternal injury) is unlikely to be referred for transport if CTG monitoring available, otherwise referral to a regional centre for a period of CTG monitoring, Kleihauer and ultrasound may be required. Tetanus prophylaxis requirements are unchanged.

References

1. Damos J, Eisinger S. Advanced Life Support in Obstetrics Course Manual. 2006. American Academy of Family Physicians.
2. Karczub A. State Trauma Guidelines for the Management of Injured Pregnant Women. Department of Health Western Australia 2012.

11 PAEDIATRICS

11.1 Paediatric Upper Airway Obstruction

Theory

1. Upper airway (laryngeal/tracheal) obstruction is potentially life threatening.
2. Cardinal features include:
 - stridor
 - tracheal tug
 - drooling
 - intercostals and subcostal recession

Depressed conscious level and low oxygen saturations are **late** signs of airway obstruction.

3. The small cross sectional area of the upper airway in young children renders them at particular risk of obstruction due to mucosal oedema, secretions and inhaled foreign bodies. According to Poiseuille's law, air flow is proportional to the radius⁴.
4. The most common cause of paediatric upper airway obstruction is Croup (viral laryngotracheobronchitis). Other causes include inhaled foreign body, epiglottitis, bacterial tracheitis, anaphylaxis, tonsillar swelling, retropharyngeal abscess and diphtheria.
5. Most children will be transported unintubated to either a regional hospital with an experienced anaesthetist +/- ENT surgeon or directly to the nearest tertiary hospital.

Pre-flight and In-flight Management

1. Flights will normally be P1 Dr accompanied
2. In a child with a compromised but functional airway, the key principle is to avoid exacerbating the situation by upsetting the child eg. Persistent attempts at throat examination, insertion of IV, attempts to gain CXR, separation from parents. Crying and struggling may see a rapid deterioration from partial to complete obstruction. Monitoring of S_aO₂ can usually be done with minimal interruption
3. Consider enlisting parents to help deliver supplemental oxygen / nebulisers / oral medications. Unintubated children will usually be transported nursed upright by a parent.
4. Oxygen should be used cautiously as it may mask signs of deterioration / impending total obstruction.
5. Bradycardia heralds complete airway obstruction prior a fall in S_aO₂. Both are pre-terminal events.
6. Intubation and needle cricothyroidotomy equipment must accompany all stages of transport. If the child completely obstructs his/her upper airway, they should be placed supine on the stretcher with optimal positioning of the airway and gently bagged with 100% oxygen. If unsuccessful at maintaining a patent airway with BVM, one **should move rapidly** to intubation (using a smaller ETT than normal). If unsuccessful, needle cricothyroidotomy may be required.
7. Preflight and inflight management will depend on both the underlying cause and severity of airway obstruction.
8. **Croup**
Stridor with barking cough and hoarseness, often preceded by 1-3 days of coryza and temp <38.5°C.

Treat with oral Dexamethasone 0.15mg/kg or Prednisolone 1mg/kg.

Consider nebulised Adrenaline (0.5mL/kg 1:1000 up to 5mL max.) which generally works within minutes and may last for up to 2 hours. Repeat nebulised adrenaline as necessary.

9. **Foreign Body Inhalation**

These flights will normally be P1/Dr accompanied.

Children present with sudden onset stridor during waking hours, without prodromal illness or fever.

When FB inhalation is either witnessed or suspected encourage examination of the airway, and if visible - remove the offending FB taking care not to push it distally. With an effective cough (child can speak, cry or breathe between coughs) it may be appropriate encourage coughing and move the child to the nearest hospital with an experienced anaesthetist and ENT surgeon.

Ensure the child is never left alone and is monitored for signs of deterioration.

Where the cough is ineffective and/or the child has lost consciousness; **immediately** follow the choking algorithm (see [The Choking Child](#)). If unconscious, perform laryngoscopy ASAP and aim to remove the FB with Magill Forceps.

10. **Epiglottitis**

Much less common than croup (since the introduction of HiB vaccine).

Suspect epiglottitis where there is high fever ($T > 39^{\circ}\text{C}$), child looks toxic, is drooling and there is minimal or absent cough.

It is most common in children between 1-6 years, but can occur in infants in adults.

There is no evidence to suggest steroids/nebulised adrenaline are of benefit in epiglottitis. Once the airway is secure, treat with IV Cefotaxime/Ceftriaxone.

11. **Bacterial Tracheitis**

Rare, but life threatening.

The child appears toxic with high fever and signs of upper airway obstruction.

The presence of copious purulent secretions from necrotic tracheal mucosa should alert the clinician to the diagnosis.

Tracheitis can be differentiated from epiglottitis by the presence of a croupy cough and the absence of drooling.

Once the airway is secure, treat with IV Cefotaxime.

Reference

1. Advanced Life Support Group. Advanced Paediatric Life Support. The Practical Approach. 5th ed. Blackwell Publishing Ltd. 2005.

11.2 Paediatric Maintenance Fluids

Theory

1. Traditional choices of maintenance fluids in paediatrics have been found to be associated with hyponatraemia and cerebral oedema resulting in significant morbidity and mortality.
2. Standard practice in paediatrics has shifted towards the use of isotonic maintenance fluids such as 0.9% saline with 5% dextrose

Pre-flight and In-flight Management

1. Ensure children over 3 months of age have 0.9% saline with 5% dextrose running as maintenance fluids if required.
2. Take specialist paediatric advice for children under 3 months of age.
3. Normal saline is an appropriate initial choice for resuscitation. The recommended initial fluid bolus in a paediatric patient showing signs of shock is 20mLs/kg NSaline. In some circumstances however, it may be more appropriate to consider giving only a 10mL/kg bolus initially. An example of such circumstances is when raised ICP is a possibility.

In a paediatric trauma patient the initial suggested fluid bolus is again 20mLs/kg NSaline unless there is uncontrolled haemorrhage when some consideration should be given to giving only 10mLs/kg in order to avoid a significant rise in systolic blood pressure precipitating further haemorrhage.

If two 20mLs/kg crystalloid boluses have been used in a paediatric trauma patient, and further boluses are required, move to using blood, if available, for further resuscitation.

4. Ensure BSL and sodium are measured pre-flight or on arrival of RFDS staff.
5. Calculate weight based maintenance requirements as follows:
 - a. 4mL/kg/hr for 1st 10kg plus
 - b. 2mL/kg/hr for 2nd 10kg plus
 - c. 1mL/kg/hr for every subsequent kg.

In some circumstances, and if the child is not showing signs of dehydration, it may be advisable to reduce the rate of fluid administration to two thirds of the usual maintenance. The rationale behind this is that unwell children often demonstrate a rise in ADH secretion. An example of such a situation is in bronchiolitis.

6. Monitor fluid balance of all children receiving intravenous fluids.
7. Correction of dehydration.

The percentage of dehydration is estimated clinically. In order to calculate the additional fluid required the following calculation is used:

Deficit in mLs = % Dehydration x Body weight in kg x 10

This is to be replaced over 24 hours. This should be **added to the maintenance** fluid requirements. Consideration should also be given to ongoing fluid losses and the rate of fluid administration adjusted accordingly.

References

1. Borland, M; Chaney, G; Vyse, D; et al. Consensus Statement on IV Fluid Usage for Maintenance Fluids in Children at PMH. Government of Western Australia, Department of Health, Child and Adolescent Health Service. 14th August 2013.
2. Advanced Life Support Group. Advanced Paediatric Life Support. The Practical Approach. Australian 5th Edition. Wiley-Blackwell
3. Princess Margaret Hospital Emergency Department Guidelines – Intravenous fluids
4. www.uptodate.com
5. Royal Children’s Hospital Melbourne Clinical Practice Guidelines – Intravenous fluids

11.3 Gastroenteritis/Dehydration in Children

Theory

1. Infectious gastroenteritis causes diarrhoea with or without vomiting.
2. Most cases can be managed with enteral hydration, however, the population base that we are often dealing with in our setting tend to present late with much more severe illness.
3. Consider differential diagnoses: sepsis and surgical causes of acute abdomen.
4. Children at risk of severe illness include those with failure to thrive, congenital illnesses, and chronic disease.
5. Those who have had attempts at rehydration with inappropriate (hyper or hypotonic) solutions (sports drinks, soft drinks (diluted or otherwise), plain water) require close attention and warrant checking electrolytes and glucose.
6. Nasogastric rehydration is the preferred route. Most children stop vomiting once NGT fluids are started. Parenteral fluids are reserved for correction of shock, respiratory illness, and hypernatraemia.
7. Assessing degree of dehydration can be difficult. Mild dehydration carries no reliable clinical signs, though the child may be thirsty. Where available an accurate weight loss is very helpful.

Table 11.1. Dehydration in Children

Moderate dehydration (4-6%)	Severe dehydration ($\geq 7\%$)
Capillary refill time >2 sec	Capillary refill time >3 sec
Increased respiratory rate	Deep acidotic breathing
Mild decrease in tissue turgor	Decreased tissue turgor
	Signs of shock (tachycardia, irritable or reduced conscious level, hypotension, anuria)

Pre-flight and In-flight Management

1. Flights for children with moderate – severe dehydration will usually be Priority 1 or 2, doctor accompanied, depending on the facilities at the referring institution.
2. Assess the degree of dehydration clinically.
3. Calculate fluid requirements.
 - A. Deficit:
 - Estimate according to the clinical picture.
 - Use last known body weight when well (if available & recent) and current weight to calculate % dehydration. If shocked work on a basis of 10% dehydration after restoration of circulating volume with 20mL/kg IV bolus.
 - A useful formula for fluid deficit is
 - Fluid Deficit (mL) = [% dehydration] x [weight (kg)] x 10
 - e.g: 10kg child, 7.5% dehydrated, deficit = 7.5 x 10 x 10 = 750mL
 - B. Maintenance requirements:
 - First 10kg body wt – 4mL/kg/hr
 - Second 10kg body wt – 2mL/kg/hr
 - Every kg >20kg – 1mL/kg/hr

- C. Ongoing losses:
- Difficult to estimate, therefore frequently review clinically and adjust rates accordingly.
- D. Total fluid requirements = A + B + C
4. Method of Rehydration; Even vomiting children tolerate NGT rehydration well, with the vomiting often subsiding. Breast feeding should be continued.
- a) Mild dehydration – usually able to rehydrate orally (10-20mL/kg/hour) or via NGT using oral rehydration solution (ORS) with 10mL/kg for every watery stool.
- b) Moderate dehydration – Rapid NGT rehydration (50mL/kg (ORS) over 4 hrs) may be suitable for those > 6months. <6months correct more slowly with NGT (ORS) with ½ fluid in first 6 hours then remainder over next 18 hours.
- c) Severe dehydration –
- Correct shock with 20mL/kg bolus IV N/Saline (ICU admission likely if needs 40 mL/kg).
 - Check electrolytes.
 - For severe dehydration or those with severe vomiting, *slower rehydration* aiming to replace ½ fluid over first 8 hours and ½ over next 16 hours (except with hypernatremia, aim to replace over 36-48 hrs).
 - If unable to commence NGT then use N/Sal with 5% dextrose unless hypernatremic. If hypernatremic seek early paediatric advice.
- Reassess regularly, noting ongoing losses, urine output and SG.
5. If no improvement consider other underlying disorders (e.g. sepsis, DKA) or severe electrolyte disturbance.
6. Investigations:
- Beware hypoglycaemia – infants and small children may require a higher concentration of dextrose. If in doubt, discuss with Paediatric ED Consultant, or regional Paediatrician. Usually 5mL/kg of 10% dextrose.
 - Hypokalaemia – common and frequently severe. Add KCl at a rate of 0.3mmol/kg/hr. Child may appear floppy.
 - Sodium – beware hypo/hypernatraemia.
7. There is some limited evidence for the use of a single dose of ondansetron with significant vomiting in children over 8kg:
- 8-15kg 2mg wafer
 - 15-30kg 4mg wafer
 - >30kg 8mg wafer
- There is no place for antidiarrhoeals or maxolon. Early feeding is recommended once rehydrated.

Medical Chest Items

Electrolyte Effervescent Tablets (Item 76)

References

1. Advanced Life Support Group. Advanced Paediatric Life Support. The Practical Approach. 5th ed. Blackwell Publishing Ltd. 2014.
2. Royal Children's Hospital, Melbourne, Australia, Clinical Practice Guideline on Gastroenteritis, [Internet, last updated ?2011; cited 13/12/2011], Available from: <http://www.rch.org.au/clinicalguide/index.cfm>
3. Shann. F. Drug Doses. ICU Royal Children's Hospital, Melbourne. 17th Ed. 2017.
4. Princess Margaret Hospital for Children, Perth, Australia, Emergency Department Clinical Guideline on Gastroenteritis, Last reviewed December 2010.

11.4 Neonate Retrievals

Theory

Generally patients up to 28 days of age (corrected for prematurity) are regarded as neonates. In Western Australia the Neonatal Emergency Transfer Service is charged with the clinical care for these babies utilising RFDS aircraft and flight nurses. This responsibility also applies to paediatricians employed by WACHS in Port Hedland and Broome.

Pre-flight and In-flight Management

1. The referral to RFDS is usually from the PMH Neonate Unit (NETS) or regional Paediatrician. The authorisation of the flight is the responsibility of the assessing RFDS medical officer, not PMH. If the request does not appear appropriate, consult the Director of Medical Services or Deputy.
2. If a request for such an infant comes from another source the assessing RFDS doctor should notify NETS or the regional Paediatrician of the case to ensure appropriate management.
3. All flight requests for a neonatal retrieval where the baby is not yet delivered must be discussed with the DMS or his Deputy. Nearly always if the mother is an active labour (even if advanced) and complicated or the baby is preterm, these patients are best transferred with baby in-utero. Flights should be Priority 1 or 2, accompanied by an RFDS doctor with tocolysis. Delivery at a tertiary centre with neonatal ICU facilities is likely to result in a better outcome for the baby than delivery elsewhere.
4. Flights for unborn babies are usually better conducted without a Paediatrician or cot, due to:
 - quicker response time
 - no room for the Paediatrician to resuscitate the infant as the neonatal cot occupies the 2nd stretcher
 - if the neonatal cot is on board, this limits access to the mother if she does deliver, especially if assistance is required.
5. Occasionally the Paediatrician will determine that a NETS retrieval is not necessary and the flight can be undertaken by RFDS staff alone. If this seems appropriate, we will undertake the flight, otherwise PMH or the regional Paediatrician (Port Hedland, Broome) should be requested to send their neonatal registrar or travel themselves. RFDS doctors are not trained in neonate retrieval per se and should not be coerced into performing retrievals outside their individual skill mix.
6. The Paediatrician may not have a lot of details on the baby and may not know the condition of the mother, so it is usual to contact the referring country doctor for more details, especially regarding the mother.
7. Neonatal retrievals should be prioritized as a Priority 1 or 2 as for other flights, even though response times for Priority 1 flights may be delayed awaiting arrival of the Paediatrician.
8. A sea level cabin may be required for babies with respiratory distress or GIT obstruction. The pilot may be asked to avoid turbulence for babies that are unstable or very preterm. Meets are contra-indicated in neonatal retrievals. The Paediatrician will always go into the hospital with the cot and Flight Nurse.
9. The RFDS Medical Officer should decide whether the mother is suitable to accompany the baby to PMH, however the demands of the baby may prevent adequate care of the mother if she is unwell. PMH have a small number of beds for mothers of sick neonates and have

a visiting midwife. A mother can only stay there if a bed is available and she has had a normal delivery and is completely self-caring without complications.

Otherwise it is usually best for the mother to remain in the country until discharged, then she can make her own way down. Sometimes sick mothers will be transferred to KEMH, but the baby still goes to PMH. If the mother is well, she travels as a passenger as she is not actually admitted to PMH.

10. The RFDS Medical Officer should also consider interim management when discussing the baby with the referring GP as he may or may not have received advice from a Paediatrician (for instance, he may only have spoken to a Nurse). Advice regarding oxygen therapy, checking blood sugar levels, fluid requirements and antibiotics may be required or the doctor can be referred back to the Paediatrician.
11. The Perth-based DFES helicopter cannot undertake neonate retrievals.

11.5 Intranasal Fentanyl

Theory

Atomized nasal medications are absorbed directly into the blood stream, avoiding first pass metabolism.

The MAD Nasal Drug Delivery Device is a fast and effective way to deliver medications without needles and is particularly useful for children.

Indications for use

Initial analgesia for children aged 1 year and older, in moderate to severe pain, with

- Fractures and dislocations
- Burns
- Major lacerations
- Painful procedures



Figure 11.1. MAD Nasal Drug Delivery Device

Contraindications

- Known Fentanyl hypersensitivity
- Altered conscious state, sedated and not easily roused
- Bilateral occluded nasal passage
- Epistaxis

Dose

1. Use 100µg/2mL strength Fentanyl solution for intravenous use.
2. **First dose - 1.5µg/kg dose**
3. A second dose may be administered 10 minutes after the first to provide adequate analgesia - **0.75 - 1.5µg/kg**
4. After 2nd dose, if further analgesia is required, review and consider alternative or additional analgesia.

Administration

1. Draw up appropriate dose for weight (see table) plus 0.1mL extra to the first dose (to account for the dead space in the device).
2. Attach Mucosal Atomiser Device on to the end of the syringe.
3. With the child sitting at approximately 45° or with head to one side, insert the device loosely into the nostril and press the plunger quickly.
4. Dose should be *divided equally* between nostrils.
5. Patient should be awake or easily rousable prior to each dose and standard observations including S_aO₂ taken regularly.
6. To improve effectiveness, minimize volume and maximize concentration. ½mL per nostril is ideal, 1mL is maximum. Use an appropriately concentrated drug.
7. Maximize total mucosal absorptive surface area. Atomize the drug (rather than drip it in) to cover a broad surface area. Use both nostrils to double the absorptive surface area.
8. Aim slightly up and outwards to cover the turbinates and olfactory mucosa.

Table 11.2. Dosage Schedule for Intranasal Fentanyl

Weight estimate (kg)	Initial dose (1.5µg/kg) (µg)	Volume – Initial dose (mL)	Top-up dose (0.75 - 1.5µg) (µg)	Volume - Top-up dose (mL)
10	15	0.3	7.5 - 15	0.15 - 0.3
12	18	0.35	9 - 18	0.2 - 0.35
14	20	0.4	10 - 20	0.2 - 0.4
16	24	0.5	12 - 24	0.25 - 0.5
18	27	0.55	13.5 - 27	0.25 - 0.55
20 - 24	30	0.6	15 - 30	0.3 - 0.6
25 - 29	37.5	0.75	18.75 - 37.5	0.35 - 0.75
30 - 34	40	0.8	20 - 40	0.4 - 0.8
35 - 39	52.5	1.05	26.5 - 52.5	0.5 - 1.5
40 - 44	60	1.2	30 - 60	0.6 - 1.2
45 - 49	67.5	1.35	67.5	0.65 - 1.35
> 50	75	1.5	37.5 - 75	0.75 - 1.5

Side effects

- Side effects are uncommon, but may include:
- Respiratory depression
- Hypotension
- Nausea and vomiting
- Pruritis
- Chest wall rigidity (only reported in large intravenous doses)

Treatment of overdose includes:

- Airway support and oxygen
- Assist ventilation
- Consider Naloxone bolus 0.1mg/kg IM or IV, maximum 2mg

References

1. Royal Children's Hospital, Clinical Practice Guidelines, (accessed 18 December 2012)
2. http://www.rch.org.au/clinicalguide/guideline_index/Intranasal_fentanyl/
3. Using the LMA MAD Nasal™ Mucosal Atomization Device. LMA 623-08/12. Wolfe Tory Medical Inc.

12 RESPIRATORY

12.1 Pulmonary Embolism

Theory

1. Pulmonary embolism may be major (life-threatening) or minor. However, missed minor pulmonary embolism or venous thromboembolism (VTE) carries a mortality rate of 15-20%.
2. Minor pulmonary embolism may result in no symptoms or non-specific symptoms. These include tachypnoea, dyspnoea, tachycardia, mild pyrexia, pleuritic chest pain or pleural rub. Most reliable risk factors include:
 - previous history of VTE
 - family history of VTE
 - unilateral swelling of one lower limb
 - pregnancy (6-9 times increased risk), oestrogen use
 - recent surgery (x 4 weeks)
 - malignancy
 - known clotting tendency (e.g. protein C or S deficiency)
 - pleuritic chest pain
 - $S_aO_2 < 95\%$ on air
3. Major pulmonary embolism can cause sudden collapse or death. The patient may have syncopal symptoms and recover, or remain hypotensive. This is often associated with central chest heaviness or discomfort, dyspnoea and a sensation of impending doom. There may also be signs of pulmonary hypertension and/or (R) heart failure. These include (R) parasternal heave, raised JVP and loud/delayed 2nd heart sound.
4. Investigations include:
 - a) clinical features or risks for DVT
 - b) ECG:
 - sinus tachycardia is most common
 - (R) axis deviation or (R) BBB
 - the classical S1, Q3, T3 pattern is uncommon and not specific for PE
 - c) D-dimer:
 - only available at regional hospitals
 - non-specific
 - d) ABGs:
 - Hypoxia and more commonly a low PCO_2 ± respiratory alkalosis secondary to hyperventilation.
 - e) CXR:
 - not always available. Used mainly to exclude other diagnoses (e.g. pneumonia). May be normal or have subtle, non-specific changes (e.g. blunted costophrenic angle, raised hemidiaphragm or plate-like atelectasis. Less common is pulmonary infarctions.
 - f) Diagnosis usually requires CTPA and/or V/Q nuclear medicine scan.

Pre-flight and In-flight Management

1. The priority and necessity for a doctor will depend on the clinical status of the patient and local resources for treating and diagnosis.
2. Oxygen to correct hypoxia – sea level pressurisation not required.
3. Circulatory support including IV fluids +/- inotropes may be required.
4. Analgesia as required.
5. Anticoagulation:
 - a) Heparin
 - sodium heparin 5000 IUs followed by an infusion at 1000 IUs/hr. (See Drug Infusion Guidelines).
 - b) Thrombolysis
 - Has been shown to decrease mortality in patients with massive pulmonary embolism and evidence of shock.
 - Tenecteplase is the thrombolytic carried by RFDS, most WACHS hospitals carry reteplase, trials specifically using these have not been undertaken however other thrombolytic agents (rtPA, streptokinase and urokinase) have been trialled at similar doses used for treating STEMI.
6. Communicate with ED/ICU consultants for patients with massive pulmonary embolism regarding patient's condition and need for ICU intervention or bed.

References

1. Brown A, Cadogan D. Emergency Medicine: Emergency and Acute Medicine Diagnosis and Management. 5th Ed. Oxford University Press. 2006.
2. Clinical Evidence. Issue 9. 2003. BMJ Publishing Group
3. Shann, F. Drug Doses. ICU Royal Children's Hospital, Melbourne 15th Ed. 2010.
4. Diepenbrock H. Quick Reference to Critical Care. 3rd ed. Lippincott Williams and Wilkins. 2008.

12.2 Acute Asthma

Theory

1. Asthma is a chronic inflammatory disease of the airways manifested by bronchospasm and reversible airways obstruction. Its pathophysiology is complex and involves inflammation of the airways, bronchial hyper-responsiveness and intermittent airflow obstruction. The degree of hyper-responsiveness generally correlates with the clinical severity of asthma.
2. It is the most common chronic illness of childhood and estimates of its prevalence vary from 2-10% of the overall population.
3. A prior history of intubation/ICU admission and poor compliance are predictors for increased severity of asthma exacerbations.
4. Clinically, manifestations are variable and dependant on the age of presentation and its severity. Generally, wheezing, cough, dyspnoea and increased work of breathing are the hallmarks. However, wheezing may be absent in severe exacerbations.
5. Severe and life-threatening asthma may present with any of the following:
 - Severe respiratory distress with accessory muscle use and indrawing as well as inability to speak in sentences
 - Drowsiness
 - Exhaustion
 - Decreased respiratory effort
 - Soft or absent breath sounds
 - Tachycardia (which may also be due to bronchodilators)
 - PCO₂ normal or increased on ABG
 - Cyanosis
 - Oxygen saturations <90%
 - Bradycardia is an ominous sign and suggests imminent cardiac arrest
6. Intubation and ventilation is fraught with difficulty however:
 - should be considered for any of the above, not responding quickly to treatment.
 - should be carried out prior to impending or actual cardiorespiratory arrest
 - should be carried out prior to transport, if not responding to treatment and exhaustion is likely during transport duration.

Pre-flight and In-flight Management

1. Flight priority depends on location and clinical severity and may range from 1-3. Generally, RFDS will be transporting severe to life-threatening cases which should be triaged as priority 1 or 2 and be doctor accompanied.
2. Consider sea level cabin for significant hypoxia that can't be addressed with supplemental oxygen.
3. Allow patients to sit as upright as possible and administer high flow O₂ to achieve and maintain S_pO₂ >92%.
4. Administer salbutamol via MDI (6 puffs 0-5 years, 12 puffs >5 years) every 20 minutes or via nebulisation (2.5-5mg in normal saline 0-5 years, 5-10mg >5 years) every 20 minutes or continuously.

5. Add ipratropium bromide if inadequate response (4 puffs via MDI or 250mcg via nebulizer every 20 minutes for the first hour if age 0-5 years, 8 puffs or 500mcg if >5 years)
6. Depending on severity administer corticosteroids orally or intravenously. (Prednisolone 2 mg/kg PO to maximum 50mg if age <12, 50mg PO if >12 years. Intravenous hydrocortisone 1-2 mg/kg IV or methylprednisolone 1mg/kg IV)

If inadequate response, consider adding:

7. Magnesium sulphate (Children 2-12 years: 0.1-0.2mmol/kg to maximum 10mmol over 20 minutes, Adults: 10mmol diluted over 20 minutes). (See Drug Infusion Guidelines.)
8. Intravenous salbutamol (Children <12: 5mcg/kg/minute to max 200mcg IV loading over 60 minutes followed by infusion of 1-2mcg/kg/minute to max 80mcg/min, Adults: 250mcg loading over 5 minutes with infusion of 3-20mcg/minute). Monitor electrolytes and lactate.
9. Consider the need for early mechanical ventilation prior to further treatment.
10. Non-Invasive Ventilation may be attempted but has **not** been shown to reduce mortality. Depending on travel distance and rates of O₂ utilization, the amount of on-board O₂ may be inadequate for transport necessitating endotracheal intubation and mechanical ventilation.
11. Humidified High Flow Nasal Cannula (HHFNC) may improve oxygenation and avoid intubation, especially in paediatric patients but is likely to require too high an oxygen flow for long distance transfer in adult patients.
12. **Indications for intubation** in the setting of acute asthma include cardiac arrest, respiratory arrest, physical exhaustion and altered mental status, inability to correct hypoxia and inability to correct hypercarbia.
13. Patients requiring intubation have mortality rates of 10-20% and mechanical ventilation in these patients is difficult and complex.
14. Pre-oxygenate patient upright until induction of anaesthesia. Administer high flow O₂ and consider the addition of high flow nasal cannula. If possible gently assist ventilation with BVM with avoidance of gastric overinflation.
15. Ketamine and propofol are the preferred induction agents.
16. Once the patient is intubated, mechanical ventilation may be difficult with the potential for severe hyperinflation due to breath stacking (increasing lung volume due to inspiration occurring before full exhalation). This can lead to barotrauma, hypotension from decreased venous return. Auto-PEEP from dynamic hyperinflation must be recognized and managed. **Lowering the respiratory rate, avoiding PEEP and increasing the expiratory time and permissive hypercapnia may reduce the risk of barotraumas.**
17. Maintain adequate sedation and, if needed, paralysis.
Initial ventilator settings for the intubated asthmatic patient:
Respiratory rate 10
Tidal volume of 4-8mL/kg
No PEEP
I:E ratio of 1:3 to 1:5
F_iO₂ 1.0
Beware the potential for tension pneumothorax- may be bilateral.
18. If peak pressures very high and impossible to ventilate or bag, consider disconnecting the ventilator and compressing the chest to reduce lung volume.

Medical Chest Items

Salbutamol aerosol spray 100mcg (Item 107), Breath-a-tech spacer and face mask (Item 229 and 230), Prednisolone tablets 5mg (Item 151).

References

1. Brenner B, Corbridge T, Kazzi A. Intubation and Mechanical Ventilation of the Asthmatic Patient in Respiratory Failure. Proc Am Thorac Soc 2009;6, 371-379
2. The Australian Asthma Handbook V.12 National Asthma Council Australia 2017
3. Acute Asthma. The Royal Children's Hospital Melbourne. May 2015

12.3 Bronchiolitis

Theory

1. Bronchiolitis is a viral infection of the lower respiratory tract, generally affecting children less than 12 months of age.
2. Peak severity of the illness occurs around day 2-3 and lasts 7-10 days.
3. Bronchiolitis is a clinical diagnosis. Typically begins as an acute upper respiratory tract infection which progresses to respiratory distress, fever and one or more of the following:
 - Cough
 - Tachypnoea
 - Retractions
 - Widespread crackles or wheezes
4. Children with any of the following risk factors are more at risk of rapid deterioration and need for escalation of care:
 - Chronological age less than 10 weeks
 - Indigenous ethnicity
 - Immunodeficiency
 - Chronic neurological disease
 - Chronic lung disease
 - Congenital heart disease
5. Clinical indicators of increasing severity of the illness include increasing irritability or lethargy, marked increase or decrease in respiratory rate, use of accessory muscles and nasal flaring, $S_pO_2 < 92\%$, decreased feeding, apnoeic spells, and increased oxygen requirements.

Pre-flight and In-flight Management

1. Usually Priority 1 or 2 and will be doctor-accompanied if child is very young, respiratory distress is severe or recurrent apnoeas are a problem. Determine oxygen requirement and need for additional respiratory support.
2. The mainstay of treatment is supportive, ensuring oxygenation and hydration.
3. Smaller babies are best nursed in a Thermocot where oxygen concentrations and temperatures are more easily controlled. Older infants may be nursed on a parent's lap with oxygen delivered by facemask. Avoid excessive handling. In both situations oxygen should be titrated to keep $S_aO_2 \geq 95\%$ and to reduce respiratory distress.
4. If significant air trapping, consider sea level pressurisation.
5. High flow humidified oxygen via nasal prongs may be instituted for children with hypoxia and moderate to severe respiratory distress despite supplemental oxygen. (See [High Flow Nasal Cannula Therapy](#)).
6. In severely ill infants intubation and ventilation may be necessary, seek advice from a paediatric intensivist.
7. There are no effective pharmacological interventions though in children close to or over 12 months with family history of asthma a trial of bronchodilator is worthwhile.

Special Notes

1. Children who are unable to drink should receive IV fluids.
2. There is an overlap between bronchiolitis and asthma. Older infants who have had recurrent episodes or who have a strong family history of asthma should be considered for a trial of bronchodilator (e.g. salbutamol ± ipratropium bromide neb). Generally infants < 9-12 months have not yet developed the receptors to respond to these drugs and nebulisers should be withheld as they can make younger infants severely hypoxic.

References

1. Clinical Practice Guideline: Bronchiolitis. The Royal Children's Hospital Melbourne
2. Mykalsen IB, Davis P, Oymar K. High Flow Nasal Cannula in Children: A literature Review. Scand J Trauma Resusc Emerg Med. Jul 2016 24:93

13 TOXICOLOGY

13.1 Snakebite

Theory

Australia's venomous snakes are all *elapids* meaning they have front fangs. Although Australian snake venoms are among the most toxic in the world, a bite does not always result in venom being injected and if it is, it is usually subcutaneous and taken up by the lymphatic system. To avoid lymphatic spread first aid includes a pressure immobilization bandage (PIB), splinting and resting the patient.

Clinical presentations of envenomation include:

Systemic symptoms

Nausea, vomiting, abdominal pain, headache, regional tender lymphadenopathy. Sudden hypotension and collapse, sometimes causing death (within 1 h of being bitten) is a rare complication of brown snake envenoming.

Coagulopathy (may present within 0-4 h)

Severe venom-induced consumptive coagulopathy (VICC), often in an otherwise asymptomatic patient. Look for bleeding gums, bleeding from venesection site, signs of intracerebral haemorrhage.

Neurotoxicity (may present within 1-6 h)

Initial symptoms are ptosis, blurred vision, diplopia, difficulty swallowing. This is followed by progressive symmetrical descending flaccid paralysis which may result in respiratory failure and death.

Myotoxicity (may present within 1-12 h)

Muscle tenderness, dark urine (myoglobin) and rhabdomyolysis leading to renal failure.

Thrombotic microangiopathy

Thrombocytopenia, microangiopathic haemolytic anaemia (MAHA) and renal failure

Pre-flight and In-flight Management

1. **Confirm appropriate first aid** (PIB should use an elastic rather than crepe bandage, include the whole limb and be applied as tightly as one would for a sprained ankle). Splinting and resting the patient can delay the spread of venom systemically for many hours.
2. Check for signs and symptoms of envenomation (see theory above). Document positive and negative findings in your pre-flight assessment.
3. The Whole blood clotting time (WBCT) is currently not recommended by the Western Australian Toxicology Service because it has not been validated for snake bites. However, it may have a benefit in very remote settings when put into clinical context. A positive test, or a negative test when the patient has signs of envenomation should always be discussed with an on-call toxicologist.

WBCT method:

Obtain 10mL of blood from patient by venepuncture

Place in a glass tube or container

Let stand for 20 minutes (do not agitate)

Then tilt container once only

If blood specimen is not clotted this implies a severe coagulopathy, i.e. patient is envenomed

Point of care INR test like the ISTAT are NOT reliable in the setting and may default to normal in the setting of overwhelming coagulopathy.

4. Advice on antivenom: Contact consultant toxicologist early by calling **13 11 26**, or through any of the major teaching hospitals in Perth (currently SCGH and RPH, not FSH). A toxicologist can advise on the type of antivenom required (multiple monovalent antivenoms, polyvalent antivenom) based on history, geography, examination findings and laboratory findings (if available). Expert opinion is considered more reliable than venom detection kits (VDK). Western Australian toxicology services currently do not recommend the use of the VDK.
5. All patients with known or suspected snake bite require evacuation to a hospital with 24-hour resuscitation, laboratory facilities and antivenom stocks (a regional hospital or a tertiary ICU for severely envenomed or complicated patients). Flights are made priority 1 or 2 with a doctor.
6. **Take antivenom with you** if not available at retrieval site. It should only be given for the following indications:
 - Coagulopathy
 - Neurotoxicity
 - Collapse or hypotension where other causes are excluded
 - Evidence of rhabdomyolysis alone or rhabdomyolysis with renal failure (this may not be testable at retrieval site)
 - Note: Non-specific symptoms like headache, sweating, vomiting and abdominal pain are not alone indications for giving antivenom.
7. Antivenom administration
 - In a monitored area with doctor present
 - Adrenaline should be drawn up (to use only in case of anaphylaxis during administration)
 - Give antivenom diluted with normal saline 500mL (10mL/kg normal saline in children) IV over 20 – 30 minutes.
 - Correction of coagulopathy requires 12-24 hours for the liver to replace clotting factors. This is not hastened by further doses of anti-venom. Commence with 1 unit of antivenom and consult a toxicologist regarding further antivenom or administration of blood products.
 - Antivenom halts progression of paralysis, however existing neurotoxicity is not reversed.
 - PIB must not be removed until patient reaches his/her destination. However, when antivenom is administered, the PIB should be removed half way through the antivenom infusion.
8. Administer tetanus prophylaxis if indicated.

References

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2. Lecture by Dr Ovidiu Pascu - RPH at RFDS base Jandakot 6 May 2010
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12. Personal communication with Dr Ioana Vlad, Emergency Medicine Physician and Clinical Toxicologist, Emergency Department Sir Charles Gairdner Hospital in Perth, 2017.

13.2 Red-back Spider Bite (RBSB)

Theory

1. The Australian Red-back Spider (*Lactrodectus mactans hasselti*) is widespread throughout Australia, both in bushland and around gardens and homes. Only bites from the female cause envenomation in humans. The venom causes the release of multiple neurotransmitters from the neuromuscular junction.
2. Clinical presentation: Bites are not immediately painful. Pain develops after 5-10 min, following by sweating and piloerection within 1 h. Pain may spread along a limb or commence at other sites (e.g. opposite limb). Sweating can be regional or generalised. Systemic symptoms include headache, nausea and vomiting, mild hypertension and tachycardia. Consider red back spider bite in children with inconsolable crying, abdominal pain or priapism.
3. Envenomation is not life-threatening and resuscitation rarely required.
4. The specific treatment for moderate to severe pain or systemic symptoms with antivenom is now thought not to provide significant benefit, as per Randomised Controlled Trial of Intravenous Antivenom Versus Placebo for Latrodectism: The Second Redback Antivenom Evaluation Study(RAVE II).

Pre-flight and In-flight Management

1. Flight requests are most likely to come from stations and nursing posts without antivenom. RBSB is not life threatening, so flights will generally be Priority 3 if at all. Flights may be doctor accompanied if other significant differential diagnoses possible in a primary retrieval.
2. Pre-flight assessment should cover areas such as recommended first aid (local crushed ice and water pack ± simple analgesics). Pressure bandage is not required.
3. Whilst now more controversial, indications for antivenom remain: Distressing systemic symptoms or pain that is not controlled with simple analgesia. Consult toxicologist for advice regarding need for administration.
4. Red-back Spider antivenom must be accessed from the regional or city hospital prior to departure.
5. Administration of antivenom
 - a. Monitored area with doctor present
 - b. Prepare for anaphylaxis (draw up Adrenaline, but not required as premedication)
 - c. Antivenom is administered as a single dose of 2 ampoules (=1000 units) given in 100mL normal saline over 20 minutes
6. Other treatment may include analgesics, diazepam and tetanus prophylaxis.

References

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6. Personal communication with Dr Ioana Vlad, Emergency Medicine Physician and Clinical Toxicologist, Emergency Department Sir Charles Gairdner Hospital, 2017

13.3 Irukandji Syndrome

Theory

1. Irukandji syndrome is a potentially life threatening, hypercatecholaminergic condition arising from jellyfish envenomation.
2. It is documented along the northern Australian coastline from Coral Bay, in Western Australia to Rockhampton, Queensland. Only *Carukia barnesi*, which is rare or absent in Western Australian waters, is proven to cause Irukandji syndrome. Other jellyfish species have been implicated but, thus far, the causative jellyfish in this region is yet to be identified.

Mechanism of Envenomation

Stinging cells (nematocysts) on the jellyfish body and tentacles contain venom and a hollow shaft. Contact triggers injection of the venom, via a harpoon like mechanism, into the victim. *Carukia barnesi* venom is thought to act as a neuronal sodium channel agonist stimulating the release of catecholamines, however, further research is required to validate this theory.

Symptoms and Signs of Envenomation

- Initial sting may go unnoticed and only minor (or no) local markings may be visible.
- May develop minor discomfort 30-120 minutes after the sting.
- Some will go on to develop systemic effects
- Majority of cases are NOT life threatening.

Table 13.1 Symptoms and Signs of Envenomation

Symptoms	Signs
Severe pain (particularly back, abdomen, chest and limbs)	Local sting site erythema, sweating, goose pimple effect (or NO local signs)
Nausea, vomiting	Generalised diaphoresis &/or piloerection
Headache	Tachycardia, hypertension*
Anxiety, agitation, feeling of impending doom	Features cardiac failure*

*Cardiac involvement in severe cases:

- i. ECG changes (atrial and ventricular ectopics, AV conduction defects, T wave inversion, ST segment elevation or depression, dysrhythmias)
- ii. Progressing to myocardial depression/ischaemia
- iii. Life threats: **uncontrolled hypertension**, toxic cardiomyopathy, cardiogenic pulmonary oedema and cardiogenic shock**

****Intracerebral haemorrhage, possibly due to uncontrolled hypertension**, has been reported in two cases in Australia (the only two reported fatalities).

Symptoms usually take up to 12 hours to resolve. However, cardiac involvement may require ICU supportive care for days.

Pre-flight and In-flight Management

First Aid:

1. Douse/spray generous volume of vinegar over sting site for 30-60 seconds. Vinegar may inactivate any unfired nematocysts. If no vinegar available, use seawater

2. Remove any adherent tentacles
3. Apply cold pack/ice in dry plastic bag to sting site (avoid contact with fresh water)
Do NOT apply PIB or rub skin – may stimulate undischarged nematocysts.

Management for local symptoms only:

Treat symptomatically. If no systemic symptoms after two hours, the patient can be discharged with oral analgesia and antiemetic and instructions to return if symptoms recur.

Management for systemic symptoms:

1. Supportive management of airway, breathing and circulation.
2. Establish monitoring (pulse, BP, RR, S_pO₂ and continuous cardiac monitoring)
3. PAIN: Fentanyl 0.5 –1.0 microgram/kg/dose IV repeated every 10 mins until pain is controlled. If fentanyl not available, give morphine 0.05-0.1mg/kg IV titrated
4. NAUSEA: Promethazine 12.5-25mg IM/slow IV (children 0.5mg/kg/dose, max 50mg)

Note: if opioid analgesia is needed for severe pain, the patient will require an observation period but *may not* need transfer (depending on local resources). In ALL cases, patients requiring opioid analgesia should only be discharged after six hour period of being symptom free.

Further management if pain or symptoms not controlled &/or haemodynamically unstable:

Perform ECG and check FBC, UEC, CK and troponin (repeat 8 hourly if haemodynamically unstable). CXR if clinical evidence pulmonary oedema. ECHO if abnormal ECG or elevated troponin, pulmonary oedema or hypotension requiring inotropes. Urgent CT head if neurological signs

If HYPERTENSIVE despite opiate analgesia: consider glyceryl trinitrate (GTN) IVI (if not contraindicated), titrated to achieve SBP <160mmHg (see RFDS GTN Infusion Guideline)

If ongoing PAIN &/or uncontrolled HYPERTENSION despite opiate analgesia: consider magnesium sulphate infusion (only after discussion with a Clinical Toxicologist as its use remains controversial)

If PULMONARY OEDEMA: (See [Acute Pulmonary Oedema](#)) (considering high flow oxygen NRB mask, non invasive ventilation or intubation and mechanical ventilation)

If CARDIOGENIC SHOCK/HYPOTENSION: consider inotropic support and need for intubation and mechanical ventilation

Cardiac arrest managed as per ALS algorithms. There is no antivenom available

Indications for transfer to tertiary facility:

ECG/ biochemical or radiological evidence of cardiac dysfunction

Signs/symptoms pulmonary oedema, cardiogenic shock or neurological dysfunction

Transport of patients with Irukandji syndrome:

Flights should be doctor accompanied, priority 1 or 2 depending on patient status and location. Anticipate massive opiate requirements for pain and possibility of evolving pulmonary oedema and cardiac dysfunction.

The patient may require ventilatory support for pulmonary oedema or to counteract respiratory depression from massive opiate requirements for pain.

RFDS doctors are advised to contact on-call Clinical Toxicologist through **Poisons Information Centre (ph 13 11 26) or Sir Charles Gairdner Hospital (6457 333) or Royal Perth Hospital (9224 2244) switchboards.**

Special Notes

Administer ADT in all cases if not current.

First aid use of vinegar may need to be reconsidered in the future –it *may* increase the amount of venom released by the nematocysts already activated.

Cold pack for analgesia is now recommended for jellyfish stings in tropical Australia.

Magnesium sulphate, clonidine and benzodiazepines *may* act as adjunct therapy for symptom control. Data is currently insufficient to recommend any of these agents as standard treatment.

Relative efficacy of different opioids (fentanyl versus morphine) remains uncertain. The best antiemetic is also unproven.

Best technique to remove tentacles is still debated – tweezers, plastic object eg credit card, gloved and bare fingers have all been suggested. It is unknown which technique is least likely to stimulate further nematocyst firing.

Medical Chest Items

Paracetamol tablets 500mg (item 178), Ibuprofen tablets 200mg (item 189), Morphine sulphate ampoules 10mg/1mL (item 188), Promethazine hydrochloride mixture 5mg/5mL (item 119).

References

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13.4 An Approach to Poisoning

Theory

- A wide range of potential poisonings and envenomations necessitates a systematic and organised approach
- A focused history and examination with directed investigations will help establish a diagnosis and yield an estimate of risk
- Stabilising the patient as far as possible prior to transport is key. This requires careful attention to resuscitation and supportive care measures, then frequent reassessments
- Specific management decisions may require consultation with a Clinical Toxicologist (**Poisons Information Centre phone 131126**)

Pre-flight and In-flight management

1. Resuscitation

Airway: If necessary secure noting that GCS is not a predictor for aspiration in this setting. Airway may be at risk from direct injury from the toxin or central nervous system depression.

Breathing: Note risk of respiratory depression or pulmonary toxicity.

Circulation: Standard ALS algorithms apply noting special cases where antidotes may be required (Digoxin specific antibodies, sodium bicarbonate, naloxone or atropine.) Also note that prolonged efforts may be required.

Monitoring: Institute full and continuous monitoring early.

Detect and treat hypoglycaemia.

Temperature control. If $>39.5^{\circ}\text{C}$ paralysis and ventilation may be required.

Seizure control in poisoning should be with benzodiazepines or barbiturates NOT phenytoin.

Antidotes for specific indications.

2. Risk Assessment

Identify all potential agents/toxins, dose(s) & formulation(s), timing of ingestion or exposure. Consider the circumstances (eg geographical location and resources available), current clinical status and important patient factors (age, weight, regular medications and co morbidities). Consider potential complications and likely timeframes. Establish what treatment or first aid already administered.

3. Supportive Care & Monitoring

Fluid therapy, analgesia, antiemetics, ADT (if envenomation) and glucose and pH monitoring. Urinary catheterisation and nasogastric drainage may be required. Patients requiring inotrope support may benefit from central venous access and invasive blood pressure monitoring.

4. Investigations

All patients require a 12 lead ECG and BGL. Serum paracetamol level is recommended in known or suspected *deliberate* poisonings. Specific toxins may warrant other specific investigations.

A pregnancy test is recommended in women of childbearing age.

5. Decontamination, Enhanced Elimination, Antidotes

Consider need for decontamination for topical exposures. Gastrointestinal decontamination (activated charcoal or whole bowel irrigation) may be used for cases where severe or life threatening toxicity is predicted and supportive care or antidote alone are unlikely to be sufficient. Discuss with Clinical Toxicologist.

Enhanced elimination (eg multidose activated charcoal, urinary alkalinisation, extracorporeal techniques) may be appropriate in some cases, again seek advice.

Specific antidotes and antivenoms can be life saving. These may need to be sourced from a regional or tertiary hospital for transport to the patient.

6. Disposition

Depends on the agent/toxin involved, severity of toxicity and predicted course. Transport to a facility with resources to provide definitive care, both medical and psychosocial.

Special Notes

Risk assessment is fundamental in helping identify those patients that need early retrieval and for predicting clinical course. It is also important to guide decision making regarding flight priority and crew mix.

In some cases, transporting resources and specialist expertise to the patient may be warranted.

Other important considerations: staff safety (contamination), co-ingestions and differential diagnoses.

Paediatric Poisoning

Approach is similar but bear in mind much smaller doses of some agents can cause significant toxicity. Children are also at greater risk of effects of envenomation (larger venom dose on a microgram/kg basis).

Poisoning in Pregnancy

Acute management follows standard approach in *most* cases, however, need to consider the effects of poisoning (and treatment) on both mother and foetus. Promptly recognising and treating any maternal compromise will also benefit the foetus. Seek Clinical Toxicologist (and possibly Obstetric) advice early.

References

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13.5 Paraquat Poisoning

Theory

1. Paraquat is a chemical herbicide available as a liquid in various concentrations up to 40+%. It also comes in water-soluble granules and as an aerosol (0.44%).
2. Serious poisoning by accidental or suicidal ingestion is nearly always fatal. Poisoning by other routes (e.g. skin absorption, inhalation) rarely causes fatalities.
3. Lethal dose is tiny - less than a mouthful (15mL) of the 20% solution is lethal. Death is due to pulmonary fibrosis (and this is made worse by the administration of oxygen which increases free radicals to attack the lungs) and renal failure. Paraquat is corrosive and can cause upper airway injury.
4. Acute toxicity may be:
 - Mild (<30mg/kg) - patients asymptomatic or develop vomiting and diarrhoea, recovery is usual
 - Moderate (30-150mg/kg) - severe (e.g. ingestion of <15mL 20% solution)
 - Vomiting and diarrhoea is followed by renal and hepatic failure and then pulmonary fibrosis
 - Death occurs in >50% but may be delayed for two to three weeks
 - Acute fulminant (>150mg/kg) - nausea, vomiting, extensive ulceration of oropharynx with acute multi-organ failure resulting in death from predominantly cardiogenic shock usually within one to four days.
5. Serum paraquat levels are important prognostically. Urine levels can also be performed.
6. There is **no antidote** for paraquat poisoning.

Pre-flight and In-flight Management

1. Risk assessment should record specific details such as time of ingestion, circumstances of poisoning, name and concentration of formulation, co-ingestants, whether substance was diluted prior to ingestion, amount ingested, timing of vomiting and last meal in relation to ingestion. Patient factors such as age, weight and medical history.
2. This is the only circumstance where decontamination takes priority over resuscitation. Patients who have ingested paraquat should receive either Fuller's earth or activated charcoal (50g) orally or even getting them to eat soil. Those who have been exposed should have been thoroughly decontaminated with soap and water, and removal of contaminated clothing.
3. Flights may be Priority 1 or 2 depending on resources available on the ground. Patients already showing symptoms of poisoning should be doctor-accompanied. There are no requirements for sea level pressurisation.
4. Early intubation or surgical airway if signs of airway injury.
5. Do not give oxygen unless saturation <90%, titrate to <91%. Lung transplantation for pulmonary fibrosis is ineffective due to fibrosis occurring in the newly transplanted lungs.
6. Treatment is that of complications (e.g. hypotension, pulmonary oedema, seizures or arrhythmias) and meticulous supportive care.
7. Enhanced elimination by dialysis or haemoperfusion may be considered up to 4 hours post exposure.
8. Ice cold fluids are used to relieve pain from oral ulceration - if not possible due to climatic conditions try diluted 1% lignocaine applied topically.

9. Death in-flight is unlikely but possible and should be handled as a Coroner's case, plus incident reporting procedures as usual.

Note: Poisoned patients do not excrete paraquat and are therefore not a risk to others, even through close contact within the confines of the aircraft.

References

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2. Saunders C, Ho M. Current Emergency Diagnosis and Treatment. 4th ed. Appleton Lange. 1992.
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13.6 Serotonin Syndrome

Theory

1. A drug induced disorder characterised by the triad of mental state change, altered autonomic stimulation and neuromuscular excitation.
2. Aetiology:
 - Any drug combination that increases serotonin levels in the CNS. Selective serotonin uptake inhibitors (SSRIs) and monoamine oxidase inhibitors (MAOIs) are the most common combination to cause this syndrome.
 - The syndrome occurs with a dose increase is made to a serotonin agonist (MAOI or SSRI) or after the addition of a second serotonergic agent. (e.g. lithium, amphetamines, cocaine, levodopa, bromocriptine, pethidine, and venlafaxine). Deliberate self poisoning is a common presentation.
3. Signs and Symptoms:
 - Mild symptoms in ambulant patients are rapid onset, non-specific, and include agitation, anxiety, restlessness, sinus tachycardia, mild hypertension, diaphoresis, hyperreflexia, myoclonus, shivering, tremor, diarrhoea and muscular rigidity.
 - Fulminant life-threatening syndrome of generalised rigidity, autonomic instability, marked mental state change and hyperthermia (Temp >39.5°C). These include coma, seizures, VT, hyperthermia, hypotension, death.
4. Diagnosis is clinical and one of exclusion of other medical and psychiatric conditions. There are no laboratory tests and drug levels if assayed are generally normal.

Pre-flight and In-flight Management

1. Pre-flight assessment should include a formal risk assessment.
2. Treatment is usually symptomatic and supportive if mild. Dramatic improvement generally occurs within 24 hours.
3. Monitor ECG, O₂ saturation. Cease all serotonergic drugs.
4. Monitor for (core temperature) and treat hyperthermia. Examine patient for clonus, hypertonia.
5. Benzodiazepines are non-specific serotonin antagonists and can be titrated to achieve gentle sedation. Other agents that may be useful in moderate to severe cases include cyproheptadine, methysergide and propranolol. Cyproheptadine is the most potent. Dose 8mg PO/NG initially. Repeat dose 8 hourly if needed. Maximum dose 0.5mg/kg/day (32mg/day). Olanzapine 5-10mg SL can be used for agitation.
6. Severe serotonin syndrome requires early, aggressive supportive care including cooling, intubation, ventilation and neuromuscular paralysis.

Special Notes

Neuroleptic malignant syndrome, anticholinergic syndrome and malignant hyperthermia are differential diagnoses.

Discuss all toxicology patients with on call clinical toxicologist at tertiary hospital (SCGH) or through Poisons Information Centre on 131 126.

References

1. Murray L, Little M, Pascu O, Hoggett K. Toxicology Handbook. 3rd Edition. Elsevier. 2015
2. Tintinalli J, Stapczynski S, Cline D, et al. Tintinalli's Emergency Medicine: A Comprehensive Study Guide. 7th ed. The American College of Emergency Physicians. McGraw Hill. 2011
3. Fulde G. Emergency Medicine, The Principles of Practice. 5th ed. Australia: Saunders. 2009.
4. Dunn R, Dilley S, Brookes J, et al. The Emergency Medicine Manual. 5th ed. Tennyson, South Australia: Venom Publishing. 2010.

13.7 Cyanide Poisoning

Theory

1. Cyanide salts are widely used in the mining industry, particularly in gold extraction, however smoke inhalation from fires in confined spaces (burning plastics and upholstery) is the most common cause of cyanide exposure.
2. Cyanide inhibits oxidative metabolism in the mitochondria resulting in lactic acidosis (lactate levels correlate with the severity of the poisoning), pulmonary and coronary vasoconstriction and neurotransmitter release causing seizures. Loss of consciousness occurs in seconds with gas inhalation or 30-60 minutes with salt ingestion. Multiple systems are affected and symptoms may progress from nausea and vomiting to headache, dyspnoea, cardiovascular collapse and agitation, seizures and coma. Investigations may show normal arterial O₂ saturations with raised CvO₂ (central venous oxygen saturation) in keeping with 'histotoxic hypoxia'.
3. Antidotes are indicated in the context of cardiorespiratory collapse and clear evidence of cyanide poisoning. In patients without cardiorespiratory collapse the indications are less clear. Evidence for use is limited, they are expensive and dicobalt edetate has a narrow therapeutic index. In the absence of comparative human trial data, treatment for cyanide poisoning is controversial and supportive care alone may be best in certain situations.

Pre-flight and In-flight Management

1. Some mine sites in WA carry antidotes – however the priority is decontamination, resuscitation and supportive care including mechanical ventilation with 100% oxygen in severe poisoning – there is no evidence for hyperbaric oxygen, and a sea-level cabin pressure should be considered but is not absolutely indicated.
2. A priority 1 doctor-accompanied flight should be tasked bearing in mind the possibility of standing a crew down given the rapid fatality of this poison. Difficulty in obtaining antidote should not delay transport – if the patient survives long enough for an RFDS retrieval they are likely to survive with or without the antidote.
3. Ensure the patient has been removed from the source and thoroughly decontaminated (washed with soap and water), clothing should be removed, placed in a sealed bag and not transported. Vomit may be contaminated. **DO NOT TRANSPORT PATIENT WITHOUT DECONTAMINATION AS THIS POSES A RISK TO CREW.**
4. Activated charcoal is ineffective in cyanide poisoning
5. Antidotes:
 - Hydroxocobalamin (*Cyanokit*). Vitamin B12 – works by chelation. The dose is 5g (2 x 2.5mg amps) in 200mL 5% dextrose over 30 min (the usual preparation available for pernicious anaemia is 1mg/mL so 5000 ampoules would be required) This preparation is not carried in the bases but may be in the local hospital or mine site. Interferes with biochemical assays (including lactate), take bloods before administration.
 - Sodium thiosulphate (increases cyanide metabolism) 12.5g IV over 10min, if no improvement in 15 min both drugs are repeated.
 - Dicobalt edetate (*Kelocyanor*) is often mentioned as an antidote but has severe toxic side effects when administered to a patient without cyanide poisoning. This is available at the bases. 300mg is given IV over 1 minute, immediately followed by 50mL of 50% dextrose IV. Repeat if necessary. The diagnosis must be 100% certain and symptoms of poisoning severe. Should be followed by Sodium thiosulphate as above.

- Some mine sites may carry kits containing amyl nitrate capsules (0.3mL each), crushed and inhaled 1 minutely until IV sodium nitrite (10mL of 3% solution (300mg) given over 2-3 min) followed by sodium thiosulphate as above. Amyl nitrate is no longer recommended as a treatment and sodium nitrite causes profound hypotension and methaemoglobinaemia and is not recommended.
- Consider discussion with a toxicologist via the WA Poisons Information Centre Ph: 131 126.

References

1. Reade M, Davies S Morley T et al. Review Article: Management of cyanide poisoning. *Emergency Medicine Australasia*. 2012. 24, 225-238
2. Murray L, Daly F, Little M, et al. *Toxicology Handbook*. 2nd ed. Churchill Livingstone. 2011.
3. Dunn R, Dilley S, Brookes J, et al. *The Emergency Medicine Manual*. 5th ed. Tennyson, South Australia: Venom Publishing. 2010
4. Baud FJ, Borron SW, Megarbane B et al. Value of lactic acidosis in the assessment of the severity of acute cyanide poisoning. *Critical Care Medicine*. 2002. 30: 2044-50
5. [WHO Model Formulary 2008](#) (Website). *World Health Organization*. 2009. p. 57. Retrieved 8 Mar 2017.

14 HAEMATOLOGY

14.1 Transfusion Medicine

Theory

1. An adequate Haemoglobin is essential to deliver oxygen to the tissues. Haemoglobin is usually replaced acutely by transfusing Packed Red Blood Cells (PRBCs).
2. Health in Western Australia uses a Patient Blood Management, a system wide program aimed at rationalising the use of blood products. This has been shown to lead to improved clinical outcomes and cost savings.
3. Transfusion decisions should be influenced by clinical need, not just laboratory parameters.
4. Transfusion of blood products can be life-saving, but they are a scarce resource and must not be wasted. They are also biological materials that are not without risk. As such they must be stored, packaged, transported, prescribed, administered and documented correctly per RFDS protocol. (See [Transfusion Medicine](#) and RFDS blood management policy document).
5. Each blood product transfused carries a small risk of an adverse effect. These can be classified as follows:
 - a. Immunological Acute (<24hrs)
 - i. Acute haemolytic (1:76000 incidence)
 - ii. Fatal haemolytic (e.g. ABO incompatibility - 1:1.8 million)
 - iii. Febrile non-haemolytic transfusion reactions (0.1-1%)
 - iv. Mild urticarial reactions (1-3% of transfusions)
 - v. Severe allergic reactions (anaphylaxis) (1:20000-1:50000)
 - vi. Transfusion-related Lung Injury (1:120000-1:190000)
 - b. Non-immunological Acute (<24hrs)
 - i. Complications of massive transfusion
 - ii. Non-immune mediated haemolysis
 - iii. Transfusion transmitted bacterial infection (TTBI)
 - iv. Transfusion associated circulatory overload (TACO)
 - c. Immunological delayed (>24hrs)
 - i. Delayed haemolytic transfusion reaction
 - ii. Allo-immunisation/GVHD
 - d. Non-immunological delayed (>24hrs)
 - i. Iron overload
 - ii. Transfusion-transmissible viral infections (HBV, HCV, HIV etc.)

Fever, chills and urticaria are the most common manifestations of transfusion reaction, but significant and life-threatening complications can occur. Also consider any delays that may be incurred by procuring blood products
6. Clotting factors may be depleted or ineffective for various reasons.
 - a. Drugs (eg warfarin, heparin, NOACs) (See [Reversal of Anticoagulation](#))
 - b. Toxins (eg snake bit envenomation)
 - c. Inadequate production (eg liver failure, hereditary coagulopathies)
 - d. Excessive consumption (eg DIC)
 - e. Dilution of factors (eg massive transfusion or fluid resuscitation)

Replacement clotting factors may be given in the form of:

- FFP (Fresh Frozen Plasma. Contains all coagulation factors)
 - Cryoprecipitate (contains most of the Factor VIII, Fibrinogen, Factor XIII, vWF and fibronectin from FFP)
 - Prothrombinex-VF (a sterile freeze-dried powder containing purified coagulation factors II, IX and X, plus low levels of factors V and VII)
 - Fibrinogen concentrate (RiaSTAP) – (via National Blood Authority for acquired hypofibrinogenemia)
7. Platelets also play a crucial role in coagulation and may be depleted by a variety of mechanisms or inhibited by anti-platelet drugs. Platelets are rarely available outside the metro area.
8. A number of drugs can also be used for the reversal of anticoagulation or as antifibrinolytics; (See [Reversal of Anticoagulation](#))
- Vitamin K – role in activation of factors II, VII, IX & X.
 - Tranexamic acid – anti-fibrinolytic increasingly used in major trauma.
 - Protamine sulphate – for heparin reversal.
 - Refer to WATAG's NOAC reversal guidelines for Rivaroxaban and Dabigatran reversal.

Pre-Flight and In-flight Management

Supply of blood products

1. Wherever possible use cross-matched products from the referring hospital. When assessing patients pre-flight request that the appropriate blood products are ordered and packed to accompany the patient.
2. If cross-matched products are not available, it may be necessary to transport products to the patient. At Jandakot base, 4 units of O negative PRBCs are kept on site as is a supply of Prothrombinex. Above this, as of July 2017 blood products can be supplied by Fiona Stanley Hospital (FSH) transfusion laboratory. Please see attached flow chart for ordering extra blood products from FSH. At regional bases, blood products need to be sourced from the local hospital (see following – Blood product supply map.)
3. FFP availability may be limited in rural areas and delays can be incurred awaiting thawing, so order early.
4. Platelets are rarely available outside the metro area. To obtain platelets at Jandakot, please consult with FSH Transfusion medicine unit via the following phone numbers:
 - a. Transfusion medicine laboratory 6152 8005
 - b. FSH Haematologist on call via Help Desk 6152 2222
5. RFDS has an account with Swan Taxis that will take blood from FSH transfusion lab to Jandakot, or Marooomba if required. At busy times (eg Friday, Sat night or around Christmas, for P1 flight, the Murdoch police can deliver blood products to Jandakot. See flow chart.
6. For flights inbound to Jandakot or Jandakot crews on “meets”, additional blood products can be arranged if necessary. Please contact the Clinical Coordinator.

Indications for blood products

Table 14.1 Indications for blood products

Product	Clinical Circumstances	Transfusion Targets
Packed Red Blood Cells	Well perfused, resuscitated, no end organ failure.	Hb 70g/L
	Evidence of end organ failure (e.g. myocardial ischaemia, raised lactate)	Hb 90-100g/L
	Severe sepsis	Hct >30%
Fresh Frozen Plasma	Coagulopathy of any cause with evidence of significant bleeding (significant either due to volume of bleeding or location e.g. intracranial)	Administer FFP 15mL/kg
	Coagulopathy of any cause without evidence of significant bleeding.	<i>Use of FFP controversial.</i> Consider if transporting patient for procedure at high risk of bleeding (e.g. emergency surgery). <i>Seek expert advice.</i>
Platelets	Evidence of active bleeding.	Aim platelets >100,000
	At risk of bleeding (e.g. trauma, perioperative)	Aim platelets >80,000
	No specific risk of bleeding.	Aim platelets >12,000
	History of anti-platelet use (e.g. clopidogrel, NSAID) with intracranial haemorrhage.	Consider platelet transfusion regardless of platelet count.
	Thrombocytopaenia secondary to auto-immune disease (e.g. idiopathic thrombocytopaenic purpura)	Platelet transfusion not indicated.

7. It is important to recognise, respond to and report adverse events. Upon recognising a transfusion reaction, you should :
- i. Stop the transfusion immediately
 - ii. Check and monitor vital signs
 - iii. Maintain intravenous (IV) access (Do not flush existing line and use a new IV line if required)
 - iv. Check the right pack has been given to the right patient
 - v. Notify your Medical Officer and Transfusion Service Provider

Table 14.2 Choice of product according to recipient ABO group.

Patient's ABO Group	Red Cells	Platelets ^a	FFP ^b	Cryoprecipitate
O				
1 st Choice	O	O	O	O
2 nd Choice		A	A or B	A or B
3 rd Choice			AB	
A				
1 st Choice	A	A	A	A
2 nd Choice	O ^c	O ^d	AB	O or B
3 rd Choice			B ^d	
B				
1 st Choice	B	A ^d	B	B
2 nd Choice	O ^c	O ^d	AB	O or A
3 rd Choice			A ^d	
AB				
1 st Choice	AB	A ^d	AB	AB
2 nd Choice	A or B	O ^d	A ^d	A or B
3 rd Choice	O ^c		B ^d	O
^a Group B or AB platelets are not routinely available				
^b Group AB FFP is often in short supply				
^c Screening for high-titre anti-A and anti-B is not required if plasma-depleted group O red cells in SAG-M are used				
^d Tested and negative for high-titre anti-A and anti-B				

Location of WA Regional Inventory: November 2016

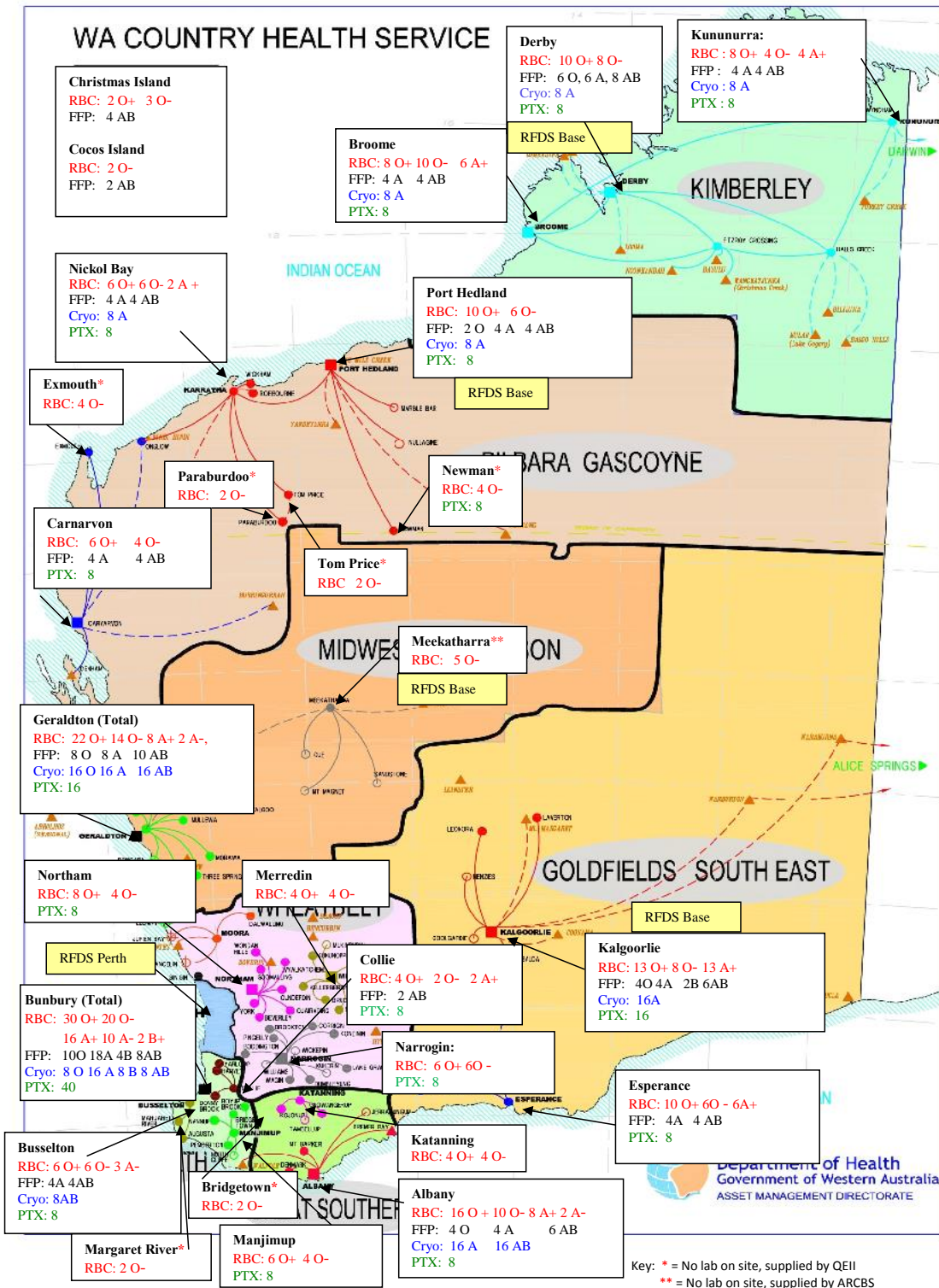


Figure 14.1 Location of WA Regional Inventory November 2016

1. Phone FSH Transfusion Medicine Unit (TMU) on **(08) 6152 8005** for pickup time
2. Either SCAN this order form to FSH.Transfusion@health.wa.gov.au or FAX: **(08) 9312 1284**

AHP/ Service: ROYAL FLYING DOCTOR SERVICE (RFDS)				
Date / Time Required:		Order Prioritisation: Routine Restock <input type="checkbox"/> Life Threatening <input type="checkbox"/>	Ordered by:	
LOCATION FOR DELIVERY Jandakot <input type="checkbox"/> RFDS phone Swan Taxi 9422 2219 state pin: "RFDS" Maroomba Airlines <input type="checkbox"/> RFDS phone Swan Taxi 9422 2219 pin: "RFDSMA"			Requesting Doctor: Contact Number:	
FSH pick up address: (this is pre-coded to the pin code at Swan Taxis) Transfusion Medicine Unit, PathWest Fiona Stanley Hospital, Pathology A GL0149 Robin Warren Drive, Murdoch, WA 6150				
RFDS to complete: Blood Product Request				
Red Cells	O NEGATIVE K NEG, rr	Quantity _____	Tick if rotating stock: <input type="checkbox"/>	FSH TMU pack info: Pack in PW Red Shipper
Fresh Frozen Plasma (FFP)	Group AB Thawed (2 available now) 25 mins to thaw more	Quantity _____		Pack in PW Red Shipper
Platelets	Group O POOL or APHERESIS (Low titre anti-A/B)	Quantity _____		ARCBS Shipper Configuration P2
Cryo-precipitate	Group AB 10 min delay to thaw	1 adult dose = 5 large bags (critical bleeding only) _____		Once thawed, store at room temp (pack P2 with platelets)
Additional Comments:				
FSH USE:				
Packed by: (print name) _____				
Picked up by: (print name) _____				
Dispatched Date/Time: _____				

FSH Staff: Leave this form for Senior Scientist follow up.

Figure 14.2 Blood Product Request

RFDS Emergency Blood Product Supply from FSH TMU

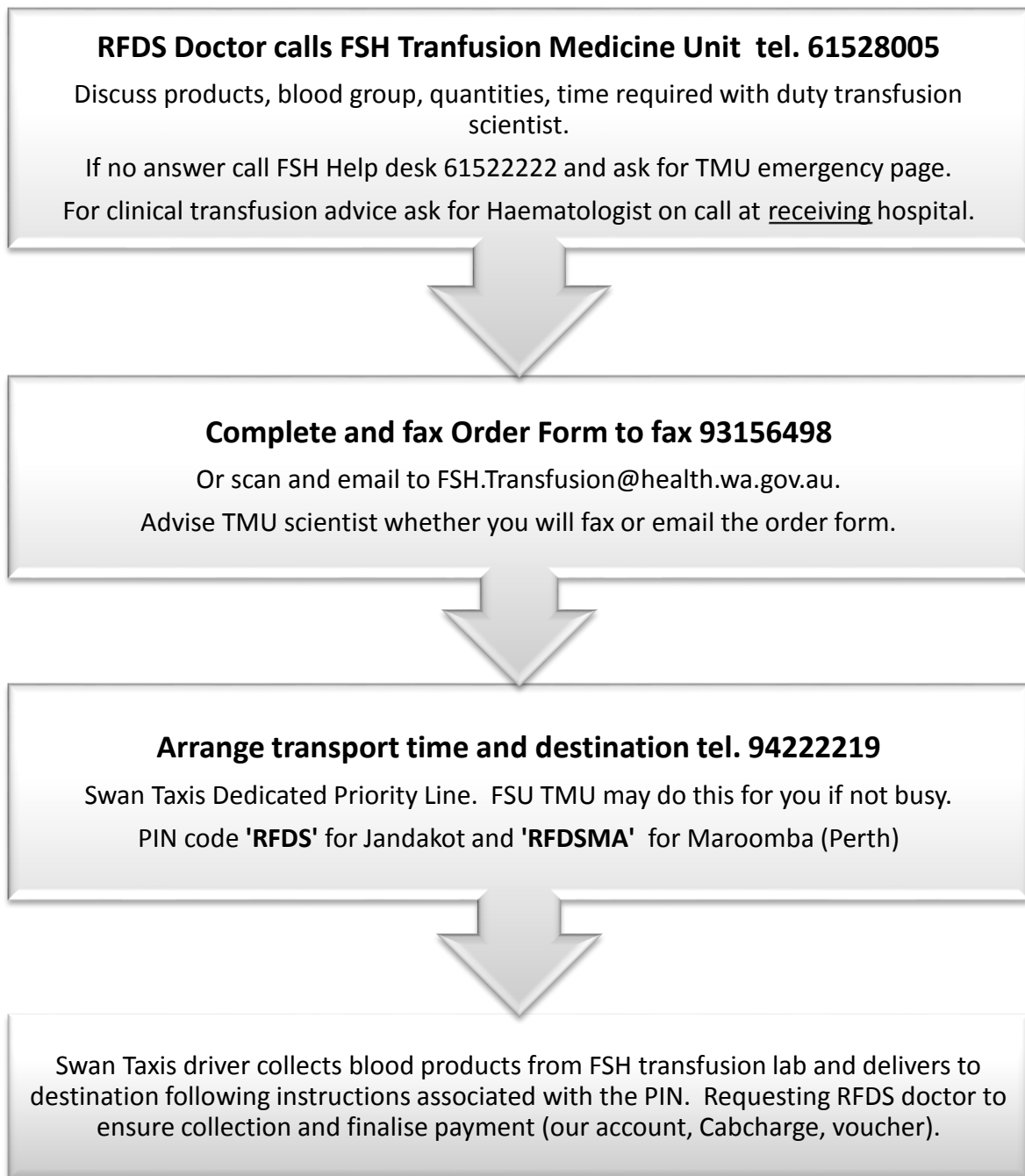


Figure 14.3 Blood Product Request Flow Chart

References

1. Authority NB. Patient Blood Management Guidelines Canberra2011 [Service ARCB. transfusion.com.au 2017 [Blood transfusion website for health professionals].
2. Carson, J et.a | Red Blood Cell Transfusion: A Clinical Practice Guideline. *Ann Intern Med.* 2012;157:49-58.
3. Shiroff A , Sarani B. When is transfusion therapy indicated in critical illness and when is it not. In: Deutschman C, Neligan P editors. Evidence Based Practice of Critical Care. Elsevier. 2010.

14.2 Major Haemorrhage

Theory

1. Massive transfusion is defined, in adults, as replacement of >1 blood volume in 24 hours or >50% of blood volume in 4 hours (adult blood volume is approximately 70mL/kg). In children, it is defined as transfusion of >40 mL/kg (blood volume in children over 1-month old is approximately 80 mL/kg).
2. Patients at risk of requiring massive transfusion should be identified early:
 - Severe trauma, blunt or penetrating (chest, abdo, pelvis, extremity)
 - Obstetric haemorrhage
 - Gastrointestinal haemorrhage
 - Vascular catastrophe (AAA or dissection)
 - Post-surgical/iatrogenic or oncological haemorrhage
 - Haemostasis unlikely to be achieved at current location
 - Prolonged PT/INR (either pharmacological or pathological)
 - Systolic BP <100mmHg
 - Hb <100 g/L
3. The goals in the management of massive transfusion include:
 - Early recognition of blood loss
 - Maintenance of tissue perfusion & oxygenation by restoration of blood volume & haemoglobin (Hb)
 - Arrest of bleeding including with early surgical or radiological intervention, and
 - Judicious use of blood components to prevent coagulopathy.
4. Early definitive haemostasis is the single most important factor in improving survival of patients with major haemorrhage. Staging patients via a regional centre with surgical facilities may be required to achieve haemostasis, in consultation with regional and tertiary centres.
5. Mortality is high in massive transfusion and its aetiology is multifactorial. Ongoing resuscitation should include measures to avoid hypothermia, acidosis and coagulopathy.
6. Hypotension in the bleeding patient is primarily due to hypovolaemia and should be treated with volume replacement. There is little role for inotropes or vasopressors unless other causes of hypotension suspected (e.g. sepsis, myocardial injury)
7. The role of permissive hypotension has only been of proven benefit in penetrating trauma in an urban environment. It may be a physiologically plausible strategy for some RFDS patients, but is not evidence based, and is contraindicated in the presence of a concurrent brain injury.

Pre-flight and In-flight Management

1. Declare major haemorrhage early. These patients will be assessed as Priority 1 doctor accompanied patients.
2. Attend to airway, oxygenation and adequate access (2 x large bore IV cannulae, or IO access).
3. Investigations FBP, Coagulation profile, ABG or VBG, lactate and crossmatch.

4. Volume resuscitation, crystalloids first line, early initiation of packed red cells.
5. Arrange supply of blood products; referring hospital, nurse manager of base hospital if flying from regional bases, or O neg from blood fridge or Major Haemorrhage pack from FSH if flying from Jandakot.
6. Minimise time to definitive care / haemostasis by avoiding “going in” if airway breathing and adequate access managed. Maintain good communication with receiving hospitals to ensure appropriate reception (e.g. straight to theatre).
7. Correct and prevent coagulopathy:
 - Secure supply of FFP / arrange thawing and transport.
 - Aim to achieve PRBC : FFP ratio of 1:1 but don't delay use of PRBC to awaiting FFP
 - Monitor and correct Ca^{2+} levels.
 - Correct warfarin induced coagulopathy – vitamin K 10mg and prothrombinex 50 units /kg.
 - Discuss with haematologist (Red Cross or receiving tertiary hospital) regarding tranexamic acid, cryoprecipitate, prothrombinex.
 - Give tranexamic acid 1g over 10min within the first three hours of trauma likely to result in massive haemorrhage followed by 1g over the next 8 hours.
 - Consider platelet transfusion – discuss with duty haematologist, only available from Perth (FSH)
8. Correct and prevent acidosis.
 - Optimise tissue oxygenation (ensure Hb >8g/dL, SBP >110mmHg, S_pO_2 >98%), arterial line and IDC useful for monitoring tissue perfusion.
 - If using large volumes crystalloid, CSL is preferable to normal saline in terms of preventing hyperchloraemic acidosis.
 - Avoid hypercapnoea (may need mechanical ventilation if patient hypoventilating).
 - Monitor Blood Gases and lactate if available.
9. Correct and Prevent Hypothermia
 - Actively warm patient. Use chemical warming blanket in flight.
 - Use warm IV fluids and blood products.
10. In summary, a [Massive Transfusion Protocol \(MTP\)](#) should be used in critically bleeding patients anticipated to require massive transfusion. The parameters in the table below should be measured early and frequently when possible (q1 hour, or after blood component transfusion).

Table 14.3 Parameters in Massive Transfusion Investigation & Monitoring

Parameters	Values to aim for
Temperature	>35°C
Acid-base status	ph >7.2, base excess <-6, lactate <4mmol/L
Ionised calcium (Ca)	>1.1mmol/L
Haemoglobin (Hb)	This should not be used alone as transfusion trigger; and, should be interpreted in context with haemodynamic status, organ & tissue perfusion
Platelet (Plt)	>50 x 10 ⁹ /L
PT/APTT	<1.5x of normal
INR	≤1.5
Fibrinogen	>1.0 g/L

Special Notes

Where extra blood products eg Major Haemorrhage packs are required, they can be obtained from FSH transfusion medicine laboratory – call 6152 8005 to speak to duty transfusion medicine technician.

A request form for blood products from FSH is on file at the Clinical Co-ordinator's desk in the RFDS Operations Centre at Jandakot.

In the setting of massive transfusion, haematology advice can be sought from the duty haematologist at Australian Red Cross Blood Service, during business hours. They have knowledge of the State's blood product supplies.

References

1. National Blood Authority. Patient Blood Management Guidelines: Module 1. Critical Bleeding Massive Haemorrhage. Australian Government 2011
2. WACHS Massive Transfusion Protocol
3. Damage Control Resuscitation
4. CRASH-2
5. NSQHS – Part 7 Blood and Blood Products
6. Australian Red Cross Blood Service – www.transfusion.org.au
7. Life In the Fast Lane: Permissive Hypotension.

14.3 Fibrinogen Concentrate in Major Haemorrhage

Theory

1. Patients with major traumatic haemorrhage, hypofibrinogenaemia and coagulopathy may benefit from administration of fibrinogen concentrate, in addition to standard major haemorrhage management. This is a current area of research.
2. There is evidence supporting the empiric administration of fibrinogen concentrate in these patients, when laboratory measurement fibrinogen levels are unavailable.
3. There may also be a role for fibrinogen concentrate in patients with major non-traumatic haemorrhage, particularly obstetric haemorrhage, GI bleed and vascular catastrophes, but this has not been evaluated in the RFDS setting.
4. In the retrieval environment, thromboelastometry is not available, so the need for fibrinogen concentrate may be obtained through either laboratory measurement of fibrinogen levels, or clinical assessment.
5. Discussion with a haematologist before administration of fibrinogen concentrate is advised.

Pre-flight and In-flight Management

Fibrinogen concentrate must be stored between 2°C to 8°C. It is located in the base fridge and should be transported in its transport bag with 2 ice blocks.

1. Indications for fibrinogen concentrate in patients with major haemorrhage:
 - Thromboelastometry demonstrating fibrinogen requirement
 - Active bleeding and fibrinogen level <2 g/L
 - Fibrinogen level <1g/L
 - Clinical evaluation of patient, including 3 of the following
 - Estimated blood loss >2L
 - SBP <90mmHg
 - Base Deficit >8mmol/L
 - Hb <70 g/L
2. Dose of Fibrinogen Concentrate is 50mg/Kg IV

Administration – Refer to administration guideline in fibrinogen concentrate transport pack.

References

1. Rossaint R et al. The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition". *Critical Care* (2016) 20:100
2. Yamamoto, K et al. Pre-emptive administration of fibrinogen concentrate contributes to improved prognosis in patients with severe trauma. *Trauma Surgery & Acute Care Open* (2016)1:1-5
3. Davenport and Brohi. Fibrinogen depletion in trauma: early, easy to estimate and central to trauma-induced coagulopathy. *Critical Care* (2013) 17:190

14.4 Reversal of Anticoagulation

Theory

1. A number of pharmacological agents used in both the acute and long term setting may predispose a patient to bleeding. These include vitamin K antagonists (VKA) such as warfarin, injectable Factor Xa and IIa inhibitors (unfractionated and low molecular weight heparin), anti-platelets agents (including aspirin, clopidogrel and NSAIDs) and now a new generation of direct oral anticoagulants (Dabigatran, Rivaroxaban, Apixaban).
2. VKA act by inhibiting the synthesis of clotting factors (II, VII, IX & X). Heparin acts primarily by deactivation of thrombin, preventing conversion of fibrinogen to fibrin clots. The NSAIDs and clopidogrel inhibit platelet adhesion by various mechanisms. Thrombolytic agents stimulate the activity of plasmin thereby enhancing the breakdown of formed clots. The mechanism of action for the new generation oral anticoagulants includes direct thrombin inhibition (Dabigatran) and direct Factor Xa inhibition (Rivaroxaban and Apixaban).
3. The patients at risk of a bleed whilst on anticoagulation can be recounted by the HAS-BLED mnemonic: Hypertension, Abnormal LFT's or renal function, Stroke history, Bleeding history, labile INR, elderly (>65), Drug and alcohol concomitant use. Trauma and other drugs may also impact the risk of bleeding on anticoagulation.

Pre-flight and In-flight Management

Warfarin

Table 14.4. Warfarin Pre-flight and In-flight Management

Clinical Setting	Action
INR >1.5 with life threatening bleeding	Cease warfarin and administer Vit K 5-10mg IV AND Prothrombinex 50IU/kg IV And 150-300mL FFP (or 15mL/kg FFP if prothrombinex unavailable)
INR >2 with significant but not life threatening bleeding	Cease warfarin and administer Vit K 5-10mg IV AND Prothrombinex 35-50IU/kg IV. Use FFP 15mL/kg if Prothrombinex unavailable
Any INR with minor bleeding	Omit warfarin, check INR the following day and adjust dose accordingly
INR supratherapeutic but <4.5 without bleeding	<ul style="list-style-type: none"> • Omit the next dose of Warfarin. • Resume therapy at a lower dose when the INR approaches therapeutic range
INR 4.5-10 without bleeding	<ul style="list-style-type: none"> • Cease warfarin therapy, consider reasons for elevated INR and patient specific factors. • If bleeding risk is high, give vitamin K (1.0-2.0mg orally or 0.5-1.0mg IV). Measure INR within 24 hrs; resume warfarin at reduced dose when INR within therapeutic range.
INR >10 without bleeding	<ul style="list-style-type: none"> • Where there is low risk of bleeding, cease warfarin therapy, give 3.0-5.0mg vitamin K orally or IV. Measure INR in 6-12 hours, resume warfarin therapy at reduced dose once INR <5.0 • Where there is high risk of bleeding (see above), cease warfarin therapy, consider prothrombinex-HT (15-30 IU/kg) or fresh frozen plasma (150-300mL) if Prothrombinex unavailable, measure INR in 6-12 hours.

Heparin

- The anticoagulant effects of Heparin may be reversed with protamine sulphate. Dose of protamine is dependent of dose of heparin to be reversed. **Maximum protamine dose, regardless of heparin dose or type, is 50mg.**
- Protamine may precipitate cardiovascular collapse if administered rapidly (minimum **infusion time – 10 minutes**). It is derived from fish sperm and therefore patients with known hypersensitivity to fish may be at risk of reaction to Protamine.
- Low molecular weight heparin (LMWH) e.g. enoxaparin – If within 8 hours of LMWH administration, use 1mg of protamine per 100 **units** of LMWH (consult LMWH product literature for number of units per mg – enoxaparin 100u/mg). If over 8 hours since LMWH administration, use 0.5mg of protamine per 100 **units** of LMWH.
- Unfractionated heparin – 1mg protamine neutralises 100 units of unfractionated heparin when given within 15 minutes of heparin. If longer than 15 mins, less protamine may be required. Consult product literature for further information.

Post thrombolytic haemorrhage (major haemorrhage or intracerebral haemorrhage)

- Manage as per major haemorrhage of other causes.
- There is no specific agent for reversal of thrombolysis.
- Be aware that a source of fibrinogen replacement may be required and therefore locate FFP or cryoprecipitate.
- Many patients receiving thrombolysis will also receive heparin and anti-platelet agents – these may also require reversal.

Anti-platelet agents

- There is limited evidence relating to the use of platelet infusions in the management of significant haemorrhage on anti-platelet agents.
- Discuss with on-call haematologist.

New generation oral anticoagulants

- Three drugs currently available in Australia: Dabigatran, rivaroxiban, apixaban. These are used for VTE prophylaxis and AF, and have said to have lower rates of life threatening bleeding. Generally orally administered twice daily, peak plasma concentration at 2-4hrs.

Basic principles of managing NOAC bleeding

- 1) Cease the drug.
- 2) Employ local haemostatic measures. (Compression, surgical, radiological)
- 3) Attend to patient ABC's (airway, oxygenation and perfusion as per ALS)
- 4) Maintain hydration to aid drug clearance.
- 5) Where possible perform full coagulation profile/ROTEM and anti factor Xa level, this will help a haematologist guide management.
- 6) Transfusion support with PRBC, platelets if platelet count < 50 x 10⁹/L or antiplatelet agent in use.
- 7) Consider Prothrombinex (25-50 IU/kg), tranexamic acid (15-30mg/kg IV) for life threatening bleeds. Any of these should involve consultation with a haematologist.
- 8) If recent ingestion of NOAC (<2hr) and life threatening bleed, consider activated charcoal in consultation with haematology/toxicology.
- 9) Consider access to dialysis for Dabigatran.

- 10) Recombinant VIIa and FFP are currently NOT indicated for DOAC bleeding. Consult haematologist.

Special Notes

- Several antidotes have become available/are in the process of being approved in Australia and throughout the world. Their utility is not yet proven
- Idarucizumab is a specific FAB for dabigatran only. Andexanet Alpha and Aripazine are designed to reverse both oral and injectable Xa inhibitors, possibly useful in the future for heparin, enoxaparin, rivaroxaban and apixaban.
- Thromboelastoplasty (ROTEM) guided management of bleeding is still in development but may become more diffusely available in the future.

References

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http://www.asth.org.au/downloads/NOAC_practical_guideline_FINAL_24062013v4_2.pdf
[Accessed 19/03/2014](#)

15 TRAUMA

15.1 Burns

Theory

1. Burns may be either:
 - Superficial (involving the epidermis) – pink, red and painful.
 - Partial thickness (epidermis and part of the dermis) – mottled pink, painful, with hairs intact, red, blistered or oedematous.
 - Full thickness (through the skin to the underlying structures) – may be black or white and leathery, painless, no hairs, may have thrombosed blood vessels.
2. Partial and full thickness burns lose copious amounts of fluid and electrolytes, especially in the first few hours, which can result in hypovolaemic shock.
3. Associated conditions may include carbon monoxide poisoning, cyanide poisoning (from burning plastics), smoke inhalation, trauma from explosions and falling debris, etc.
4. Calculation of area involved by the burn. NB. erythema alone is not included:
 - a) Adults, older children - "Rule of Nines":
 - 9% for head, each upper limb
 - 18% for anterior trunk, posterior trunk, each lower limb
 - 1% for perineum
 - b) Infants, small children – Lund-Browder Chart:
 - Figures below are for 1 year olds. For each additional year, subtract 1% from the head and add to lower extremes:
 - i. 19% head
 - ii. 12.5% each lower limb
 - iii. other percentages as above
5. Burns greater than 25% result in a widespread systemic response and generalised oedema including pulmonary and airway even if no direct respiratory injury. The American Burns Association defines a severe burn as being >20%, although burns of less than this percentage can also be considered severe in children or the elderly.

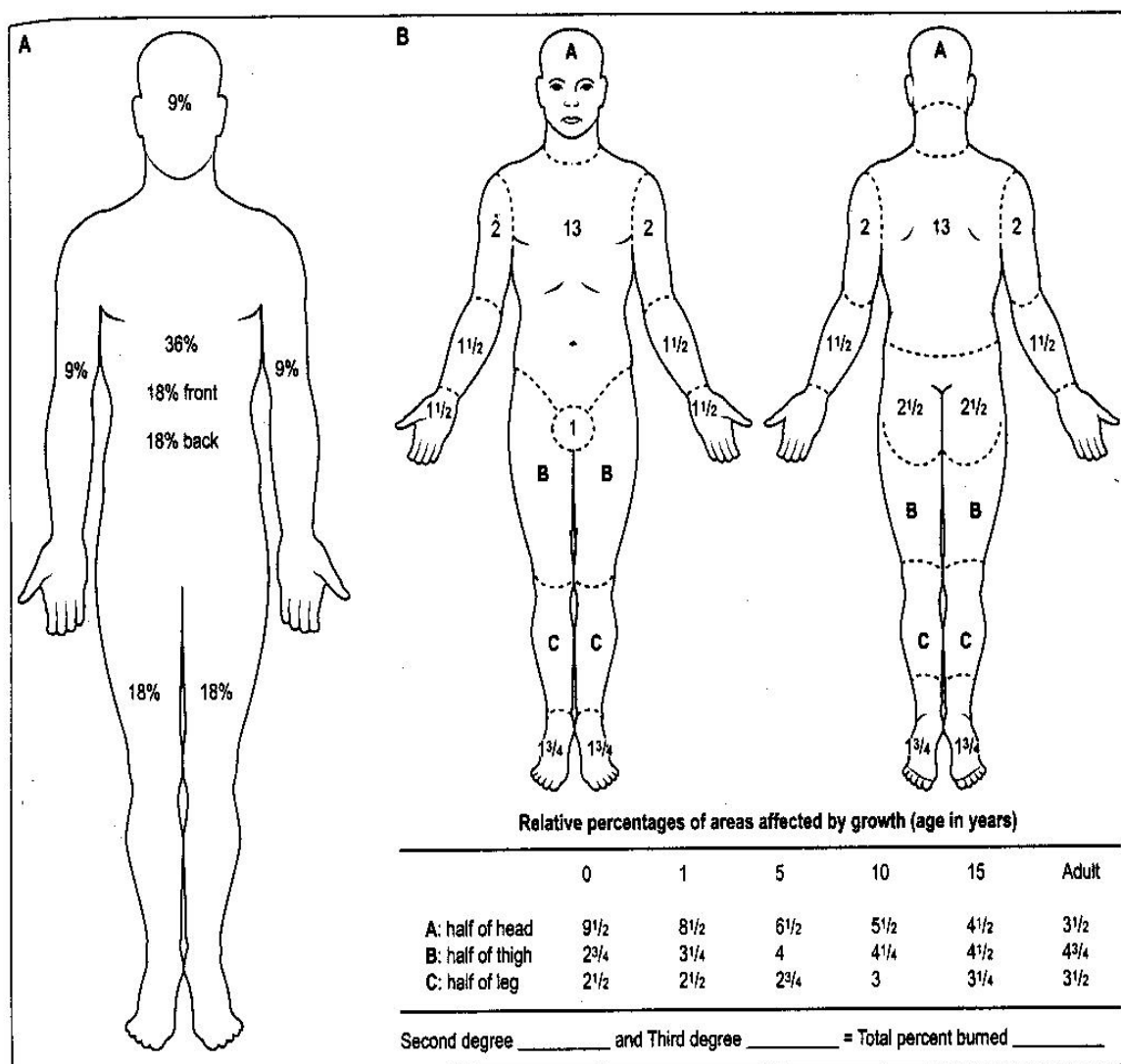


Figure 15.1. Relative percentages of areas affected by growth (age in years)

Pre-flight and In-flight Management

1. Pre-flight management and advice will be directed at removing the offending agent, the ABC's, cooling the burns (ensure 20 min of cooling with running water if possible) and establishing IV access and commencing fluid replacement. The patient should be covered to prevent heat loss. Remember coexisting injuries/illnesses. Speak to a burns unit early.
2. Flights may be Priority 1 or 2 and may be doctor accompanied depending on the age of the patient, the extent of the burns and the medical facilities available locally.
3. Attempt to get as much information as possible about mechanism of injury.
4. Dressings:
For transport, all burns should be dressed with Acticoat or SSD cream (not to the face), gauze, sheets or non-stick dressings, and crepe bandages. Wet dressings and clingfilm slide off, predisposing the patient to infection and hypothermia. Do not apply clingfilm in a circumferential fashion.
5. A cache of Acticoat dressings sufficient to manage up to 80% BSA in an adult, or less in multiple patients is available at each base and should be taken to dress extensive burns if not available at referring location.
6. Remove all clothing and jewellery.

7. Facial burns should be dressed with vaseline or sterile emollient, with chloromycetin ointment to the eyes and eyelids.
8. Fluid management (Parkland formula). The American Burns Association suggest formal fluid resuscitation should be given to all patients with >15% nonsuperficial burns.
 - 2-4mL/kg/%SA of burn in addition to maintenance fluids.
 - Give ½ in first 8 hours from time of burn. Give remainder over 16 hours.
 - Hartmann's solution is usually the chosen rehydration fluid for both adults and children. Children will require their usual maintenance fluid in addition to the rehydration fluid calculated via the Parkland formula. NSaline with 5% Dextrose is appropriate for this maintenance fluid. Monitor BSL and electrolytes regularly in all patients, especially in children.
9. Aim to maintain urine output >0.5mL/kg/hr (>1mL/kg/hr in children). Monitor for haemo/myoglobinuria. Fluids may need to be increased to push urine output to 2mL/kg/hr. Mannitol diuresis may be required.
10. Non invasive blood pressure measurements may be inaccurate, arterial lines are useful for large burns.
11. Monitoring pH and lactate may be useful measures of adequacy of tissue perfusion / resuscitation.
12. All patients with major burns should have an IDC inserted and NGT (gastroparesis is common).
13. Analgesia: Burns are very painful and administration of sufficient analgesia may necessitate intubation to protect the airway. IV opioids should be titrated or given by infusion pump.
14. Management of airway burns:
 - Suspect if there are substantial facial burns, oral erythema or blistering, carbonaceous sputum, hoarse voice or stridor.
 - Management includes early intubation before oedema makes this impossible. Suxamethonium can be used in a rapid sequence induction provided burns are <72 hours old (<48 hours old in children)
15. Escharotomy: must be performed if circumferential burns are preventing adequate perfusion of the extremities (watch neurovasc obs, deep pain at rest or on passive movement of distal joints), or are impairing respiration. The eschar is split longitudinally with a scalpel, down to bleeding tissue. No analgesia/anaesthesia is required. Advice should be sought from burns consultant at the time to avoid unnecessary injury to peripheral nerves etc.
16. Elevate all involved limbs.
17. Suspect and treat, if required, for carbon monoxide and cyanide poisoning. Consider taking cyanide antidotal therapy with you.
18. All burns patients require tetanus prophylaxis.
19. Admission to a hospital with a specialist burns facility is recommended for;
 - burns >10% BSA,
 - circumferential partial thickness or full thickness burns,
 - chemical or electrical burns or
 - burns to special areas i.e. face, neck, hands, feet, perineum, joints or inhalational burns.

References

1. Dunn R, Dilley S, Brookes J, et al. The Emergency Medicine Manual. 5th ed. Tennyson, South Australia: Venom Publishing. 2010.
2. Barnden L. Assessment and treatment form for adult burn victims. Royal Perth Hospital, 1995.
3. Personal communication, CNS Joy Fong, Burns Unit, Royal Perth Hospital, 2000
4. Australian & New Zealand Burn Association. Emergency Management of Severe Burns Course Manual. 15th Ed February 2011.
5. APLS Australia manual 5th Edition
6. www.UpToDate.com
7. Princess Margaret Hospital Emergency Department Paediatric Acute Care Guidelines – Burns -Fluids

15.2 Hydrofluoric Acid Burns

Theory

1. Hydrofluoric acid (HF) is an inorganic acid used in both domestic and industrial processes.
2. HF causes a unique chemical burn which can lead to both tissue destruction and potentially fatal systemic toxicity. It can present anywhere along a spectrum from a minor dermal injury to the life threatening.
3. There is often a delay in the presentation of a HF burn. Stronger concentrations of HF cause symptoms sooner than weaker solutions. Pain can be out of proportion to local signs of tissue damage.
4. HF is highly lipophilic and therefore readily penetrates through skin and nails causing destruction of deeper tissues and may cause osteolysis. Fluoride ions complex with calcium and magnesium leading to hypocalcaemia, hypomagnesaemia and hyperkalaemia, which may manifest as a long QT interval +/- cardiac arrhythmias.
5. Patients at high risk of systemic toxicity are:
 - i. Burn caused by HF >50% concentration
 - ii. Burn >5% Body Surface area (with any concentration of HF)
 - iii. Where the history suggests HF ingestion or inhalation.
 - iv. Prolonged exposure/delayed treatment of low concentration HF.

Pre-flight and In-flight Management

1. Pre-flight management advice should include copious lavage with tap water (eg. 30 mins). No other decontamination agent has been shown to be superior to first aid water irrigation.
2. Following irrigation, 2.5% calcium gluconate gel* should be massaged into the burn area and can be repeated at 30 minute intervals. This inactivates fluoride ions and provides analgesia which in itself is an indicator of effectiveness. For burns to the hands / fingers, a surgical glove can be filled with gluconate gel which can then be worn as a dressing over the affected area.
3. Assess for features of systemic toxicity: nausea, vomiting, abdominal pain, convulsions, hypotension, long QT, cardiac arrhythmias and cardiac failure.
4. Check electrolytes including K⁺ and Ca²⁺ using iStat CG8. Replace calcium as necessary (may require calcium gluconate infusion) and consider empiric magnesium supplementation.
5. Where there is failure to respond to topical calcium gluconate gel, consider seeking specialist advice which may include:
 - i. Intradermal injection of 10% calcium gluconate with a 26G needle.
 - ii. Intra-arterial calcium gluconate, administered via an arterial line.
 - iii. Calcium gluconate administered intravenously via a Biers Block.
6. Where systemic toxicity is suspected, consider urinary alkalisation +/- urgent transfer for haemodialysis to enhance fluoride ion excretion.
7. In exceptional circumstances (eg. Cardiac arrhythmias), urgent surgical debridement/amputation may be warranted to remove the source of fluoride ions.
8. Where a nail has been exposed to HF and severe pain is present, the nail should be removed (after ring block) and Calcium Gluconate Gel applied to the nail bed.

9. For ocular HF burns, encourage immediate and extensive irrigation with water. Seek ophthalmological opinion early re: Calcium gluconate eye drops.
10. Inhalational exposure can be managed with nebulised calcium gluconate 2.5%.
11. Flights will usually be Priority 2. Where the burns are more than very minor, the flight should be doctor accompanied.
12. All patients should have serial 12 lead ECGs, and receive cardiac monitoring during flight. The QT interval can be used as a guide to the adequacy of calcium supplementation.

Special notes:

* 2.5% Calcium gluconate gel can be made by adding 30mL of water soluble lubricant (eg. Apicare or K-Y Jelly) to 10mL of 10% Calcium Gluconate topically. When applying gluconate gel directly to a burn area, ensure the user wears 2 pairs of surgical gloves.

Should intubation be required, avoid the use of Suxamethonium due to the risk of hyperkalaemia.

References

1. Dreisbach R, True B. Dreisbach's Handbook of Poisoning: Prevention, Diagnosis and Treatment. 13th ed. Parthenon Publishing. 2001.
2. Saunders C and Ho M, Current Emergency Diagnosis and Treatment. Appleton Lange. 4th Ed. 1992.
3. Ellenhorn M. Medical Toxicology Diagnosis and Treatment of Human Poisoning. 2nd ed. Williams and Wilkins. 1997.
4. McKee D, Thoma A, Bailey K, Fish J. A review of hydrofluoric acid burn management, Plastic surgery 2014 Summer; 22(2): 95-98
5. Kaushik S, Bird S. Topical Chemical Burns, Uptodate.com (April 2017)

15.3 Identification and Management of Pelvic Fractures

Theory

The sacrum, ilium, ischium and pubis, along with a large number of ligamentous complexes, comprise the pelvis. Fractures and ligamentous disruptions of the pelvis suggest that major forces were applied to the patient, e.g. Ejection from a motor vehicle, crushing injury, pedestrian struck by moving vehicle or motorcycle collision. Pelvic fractures have a significant association with injuries to intra and retroperitoneal visceral and vascular structures. Therefore, hypotension may or may not be related to the pelvic fracture itself when blunt trauma is the mechanism for injury. Blood loss in a pelvic fracture is from the ends of the fractured bones, associated injuries to pelvic muscles, presacral veins and pelvic arteries

Pre-flight and In-flight management

1. These patients would usually be Priority 1 or 2 depending on the referring location and amount of pre transfer stabilisation. If there multiple injuries or the patient is unstable then the flight is likely to be doctor accompanied.
2. After checking airway, breathing and circulation ensure adequate IV access and fluid resuscitation, add supplemental oxygen.
3. Pelvic splinting should occur early as part of managing circulation. Techniques to Reduce Blood Loss from Pelvic Fractures.
 - Avoid excessive and repeated manipulation of the pelvis.
 - Internally rotate the lower legs to close an open-book type fracture. Pad bony prominences and tie the rotated legs together. These manoeuvres may reduce a displaced symphysis, decrease the pelvic volume, and be used as temporary measures until definitive treatment can be provided.
 - Apply pelvic splint such as T-pod device, SAM or other pelvic binder. Coordinate patient movements to ensure minimum handling, eg one log roll only and ensure binder, spinal exam, and removal of clothing debris etc all done in that movement.
4. Examination:
 - Inspect the pelvic area for ecchymosis, perineal or scrotal haematoma, or blood at the urethral meatus.
 - Inspect for leg-length discrepancy or rotational deformity.
 - If circumstances permit, in a male perform a rectal examination, as a high riding prostate gland is a sign of a significant pelvic fracture, note any palpable fracture, or the presence of gross or occult blood in the stool.
 - In a woman perform a vaginal examination, noting palpable fractures, the size and consistency of the uterus, or the presence of blood. Remember that women of childbearing age may be pregnant.
 - Palpate the bony pelvis to identify painful areas.
 - Determine pelvic stability by gently applying anterior-posterior compression and lateral-to-medial compression over the anterosuperior iliac crests. Testing for axial mobility by gently pushing and pulling on the legs will determine stability in a cranial-caudal direction. This should only be **performed once**, if at all, as repeated testing for instability may dislodge clots from coagulated vessels and result in fatal haemorrhage.
5. Cautiously insert a urinary catheter if no blood is seen at the urethral meatus, otherwise a retrograde urethrogram will be needed.

6. Interpret the pelvic x-ray, giving special consideration to those fractures that are frequently associated with significant blood loss, eg, fractures that increase the pelvic volume. Systematically evaluate the film for:
 - Width of the symphysis pubis - greater than 1 cm separation signifies significant posterior pelvic injury.
 - The integrity of the superior and inferior pubic rami bilaterally.
 - The integrity of the acetabula, as well as femoral heads and necks.
 - Symmetry of the ilium and width of the sacroiliac joints.
 - Symmetry of the sacral foramina by evaluating the arcuate lines.
 - Fracture(s) of the transverse processes of L-5.
 - The pelvis is a ring that rarely sustains an injury in only one location. Displacement of ringed structures implies two fracture sites.
 - Remember, fractures that increase the pelvic volume, e.g. vertical shear and open-book fractures, are often associated with massive blood loss.
7. Obtain early surgical and orthopaedic consultation to determine priorities.(Royal Perth Hospital Trauma line 1800-631-798)

Reference

1. American College of Surgeons. Advanced Trauma Life Support. Student Manual. 8th ed. 2008

15.4 Crush Syndrome

Definition

The systemic manifestations of muscle ischaemia secondary to compartment syndrome.

Theory

1. First described in civilians buried under debris from collapsed buildings during the London Blitz in World War II. Other causes include earthquakes, mining accidents and prolonged unconsciousness (e.g. drug overdose) where the patient's limbs are compressed by their own body weight. The diagnoses should be suspected in these circumstances.
2. The clinical presentation includes the following:
 - Signs of compartment syndrome: swollen, tense muscle compartments; pain in conscious patients, especially on passive stretching of affected muscles.
 - Pressure marks, including clothing patterns.
 - Reduced perfusion to peripheries. NB: Peripheral pulses disappear late.
 - Cardiovascular: hypertension, tachycardia, arrhythmias secondary to hyperkalaemia.
 - Metabolic: metabolic acidosis, hyperkalaemia, and acute renal failure secondary to myoglobinuria, DIC.

Pre-flight and In-flight Management

1. These would usually be Priority 1 or 2 and Doctor-accompanied, depending on the facilities at the referring location.
2. There should be a low threshold for suspecting the diagnosis and treating early. Hyperkalaemia and metabolic acidosis can be confirmed using i-STAT. Urine may be discoloured dark red-brown from myoglobin, with dipstick positive for blood.
3. Good IV access with preferably two 16g cannulae, urinary catheterization, supplemental oxygen and splinting of any associated fractures should also be ensured.
4. Maintenance of high urinary output (e.g. >2mL/kg/hr) with IV fluids (usually 1 litre/hr initially in an adult) and consideration of IV mannitol, + dopamine infusion, unless anuric. Seek ICU advice for specific management.
5. Consider urinary alkalinisation with sodium bicarbonate 1mmol/kg.
6. Manage hyperkalaemia (See [Hyperkalaemia](#)).
7. Transport early for definitive care, which includes haemodialysis, fasciotomy and debridement of dead muscle, and ICU management.
8. For management of associated compartment syndrome please see RFDS compartment syndrome guideline

Reference

1. Dunn R, Dilley S, Brookes J, et al. The Emergency Medicine Manual. 5th ed. Tennyson, South Australia: Venom Publishing. 2010.

15.5 Compartment Syndrome

Definition

Compartment syndrome is a limb-threatening condition caused by an increase in the pressure of a muscular compartment ultimately leading to compression and ischemia of nerves, muscles and vessels within that compartment.

Theory

1. May be caused by limb fractures (most common, with tibial, supracondylar and forearm fractures the most likely), extrinsic compression, burns, reperfusion of an ischemic limb, coagulopathy, crush injury, snakebite, seizures.
2. Pathophysiologically, the muscles are contained within inelastic fascial sheaths. When compartment pressure rises, capillary pressure is exceeded and ischemia ensues.
3. Normal tissue pressures range from 0-10mmHg. Capillary blood flow will become compromised at compartment pressures over 20mmHg while muscle and nerve become ischemic with compartment pressures over 30mmHg. These pressures may still be tolerated if the perfusion pressures are high enough. Treatment recommendations may be made based on absolute pressures or on the Delta pressure:

Delta Pressure= Diastolic BP- Intracompartmental Pressure (<30mmHg=CS)

4. The definitive treatment is fasciotomy of the affected muscle compartment, preferably within 6 hours. Due to time delays and distances for aeromedical transfer, this may need to be done prior to the flight, or possibly in flight to avoid irreversible damage.
5. Beware associated complications such as rhabdomyolysis and hyperkalemia.

Pre-Flight and In-Flight Management

1. Depending on the time frame, resources available at the referring institution, and potential need for an emergent fasciotomy this could be Category 1, 2, or 3 with or without a doctor.
2. Consider the need to divert to a regional facility with a surgeon available to perform fasciotomy.
3. Clinically look for the 6P's (pain, parasthesia, paresis, pallor, poikilothermia and pulselessness). However, the most sensitive clinical signs are pain out of proportion and pain with passive stretching. Loss of nerve function and pulselessness are LATE signs.
4. To reduce potential further injury, elevate the affected limb to the level of the torso, remove circumferential dressings and plaster casts or other splinting devices. Non-circumferential backslab immobilization is adequate for fracture stabilization.
5. Provide adequate analgesia.
6. Measure the compartment pressure. Several methods are available including commercially available kits. However, in the RFDS setting using an 18g needle (or a 16g intravenous cannula with a small slit cut into the plastic cannula 1 cm from the distal end) hooked up to an arterial line pressure transducer system will give equally accurate compartment pressure readings. The same pressure transducer that we carry for arterial lines can be used to measure compartment pressures.
 - Using aseptic technique and a scalpel cut a small port 1cm from the sharp end of a 16G IV cannula (trocar still in situ).
 - Prime cannula with normal saline prior insertion.
 - Insert cannula within 5cm radius of fracture site, at 90° to the skin and depth of 2 cm. (Consider local anaesthetic for skin)

- Remove trocar and attach primed transducer set
- Zero transducer at level of limb.

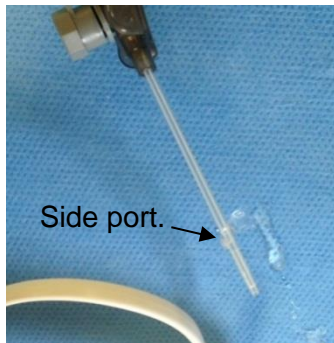


Figure 15.2. IV cannula modified with side-port to monitor compartment pressures with artline transducer.

7. Provide adequate intravenous fluids to avoid hypotension and treat rhabdomyolysis, if present.
8. Perform or arrange for fasciotomy in consultation with the accepting orthopaedic surgeon.

References:

1. Stracciolini, Andrea, Hammersby, E. Mark: Acute Compartment Syndrome of the Extremities. Up to Date; May 13, 2016 <http://www.uptodate.com/contents/acute-compartment-syndrome-of-the-extremities>
2. Rasul, Abraham T.: Acute Compartment Syndrome Treatment and Management. Medscape Jan 17, 2017

15.6 Fractured Neck of Femur

Theory

1. These are hip fractures and have various classifications according to anatomic location of the fracture.
2. Whilst orthopaedic surgeons in WA have expressed a desire to have these patients on the operating table within 4 hours of injury (in order to maintain vascular viability of the femoral head), this is not a realistic goal and only applies to Garden I and II non-displaced or minimally displaced subcapital fractures of the femoral neck.
3. There is clear evidence that delay in surgical repair of greater than 48 hours increases morbidity and mortality.
4. There is no evidence to support the use of skin or skeletal traction pre-operatively.

Pre-Flight and In-Flight Management

1. Notwithstanding the above, these will generally be prioritized as Category 3, nurse only, in the absence of other injuries or significant co-morbidities.
2. Suggest to referring physician that a femoral nerve block should be placed prior to transfer.
3. Indwelling catheter should generally be placed prior to transfer.
4. Adequate intravenous access.
5. Patients should be transported on a pressure-relieving mattress and consider placing a pillow between the legs for comfort and positioning.
6. Ensure distal pulses are present.
7. Give adequate analgesia with titrated morphine or fentanyl.

References

1. Mak, Jenson CS, Cameron, ID, March, Lyn M: Evidence-based Guidelines for the Management of Hip Fractures in Older Persons: An Update. Med J Aust 2010;192(1):37-41

15.7 Screening Adults with Suspected Cervical Spine Fractures

Theory

1. **Epidemiology:** In blunt polytrauma the prevalence of cervical spine injury (CSI) is 2.8% in alert, 7.7% in obtunded patients, and 1-2% in the paediatric population. Prevalence of spinal cord injury (SCI) is 0.1% in alert and 0.5% in obtunded patients.
2. **Biomechanics:** Significant force is required to create a CSI (2-6kN). The damage is done at the time of the injury and requires energy transfer rather than movement per se to create a SCI. Thus normal patient care, including extrication or moving the patient into a neutral position are safe. Patients who are able to self extricate should be allowed to do so.
3. The use of rigid collars in particular, and immobilisation in general, has a poor evidence base. There is no evidence for the effectiveness of rigid collars. However, the following complications may occur when they are used: increased pain, airway and respiratory compromise, failed intubation, increase in intra-cranial pressure, increased motion sickness, aspiration, increased movement in the upper cervical spine, and increased mortality when GCS <9. The WA State Trauma Committee still recommend the use of rigid collars however this may change in the future and clinicians are expected to use their best clinical judgement.
4. **Selective immobilisation:** Routine immobilisation should not be practiced. Obtunded patients with multiple injuries should be assumed to have a CSI until proven otherwise. Alert stable trauma patients without neck pain, those with isolated penetrating injury, and those being treated for a suicide attempt post hanging should not be immobilised.

Canadian C spine Rules (CCSR) and NEXUS rules have been prospectively validated in pre-hospital settings. Patients who meet the all of the following criteria should be clinically cleared as soon as possible:

- A normal level of alertness,
 - No evidence of intoxication,
 - Absence of a focal neurological deficit,
 - Absence of tenderness at the posterior midline of the cervical spine, and
 - The absence of pain elsewhere that distracts the patient from the pain of a cervical spine injury. A patient who can “engage” with your assessment does not have distracting injury.
5. **Spinal immobilisation:** Spinal boards are to be used for short term extrication purposes only. Vac mats should be used for transfer with the patient secured in a neutral position. Rolled towels and IVI fluids can substitute for sandbags. The head should be taped.

Pre-flight and In-flight Management

1. Patients with suspected CSI and neurological signs should be transferred to a facility with MRI.
2. Patients with suspected CSI and requiring full immobilisation may require a second pair of hands for transfer and in flight; either second flight nurse or doctor.
3. Consider the risks and benefits of immobilisation / rigid collar on an individual basis.
4. Patients who have not been clinically cleared and are being transferred without a rigid collar should have a clearly visible label identifying that the c-spine has not been cleared.
5. Patient should be well enough secured and cocooned in vac mat to enable rolling with only two persons should the patient vomit.

References

1. Anaesthesia, Trauma, and Critical Care (ATACC) Manual, 2014 [cited 19.03.17]. Available from www.atacc.net.
2. Hauswald M. A re-conceptualisation of acute spinal care. *Emerg Med J* 2013;30:720-723.
3. Sundstrom T et al. Prehospital use of cervical collars in trauma patients: a critical review. *J Neurotrauma* 2014; 31: 531-540.
4. Queensland Ambulance Service. Spinal Immobilisation: Evidence Review, 2015.

15.8 Acute Spinal Cord Injuries

Theory

1. The commonest presentation of acute SCI in the conscious patient is neck or back pain with flaccid paralysis below the level of injury. The damage occurs at the time of injury. Management is supportive.
2. Secondary SCI occurs between 2-48 hours after injury and occurs due to haemorrhage, inflammation, and oedema, resulting in cord ischaemia.
3. There is no evidence that spinal immobilisation reduces the severity of, or prevents SCI.
4. Neurogenic shock occurs in 20% of patients with lesions at T6 and above, usually within 30 minutes of injury, and leads to hypotension, bradycardia and poikilothermia. This is distinct from “spinal shock” which describes absent or decreased sensation and reflexes, and flaccid paralysis resulting from autonomic dysfunction
5. Circulatory disturbances are common. A MAP >85mmHg is recommended.
6. In the injured patient shock should be presumed to be haemorrhagic in origin until proven otherwise.
7. Steroids have no role in the management of acute SCI.
8. Respiratory compromise is common, especially in high lesions.

Pre-flight Management

1. Most flights will be Priority 2 and may not require a doctor. A doctor should accompany the flight if the cord lesion is high (and increasing oedema may affect innervation of respiratory muscles), if there are associated injuries requiring a doctor or the patient is shocked. Pilots should be requested to avoid turbulence. Transfer to a definitive centre within 24 hours on injury is recommended.
2. Alert patients should be packaged in a vac mat in position of comfort with the head elevated.
3. An IDC and NGT should be inserted.
4. Avoid fluid overload in neurogenic shock. Metaraminol or noradrenaline may be used. Monitor urine output
5. Protect the skin – pressure relief and protection of bony prominences are important from the outset during transfer.
6. Prevent hypothermia.
7. Routine antibiotics are not indicated.
8. Adequate analgesia is required and morphine is the agent of choice.

References

1. Anaesthesia, Trauma, and Critical Care (ATACC) Manual, 2014 [cited 19.03.17]. Available from www.atacc.net.
2. Trauma Victoria. Spinal Trauma Guideline, 2014. [cited 20.03.17]. Available from <https://trauma.reach.vic.gov.au>
3. See also RFDS Western Operations Clinical Manual 1.1 Guidelines for Screening Adult Patients with Suspected Cervical Spine Injury.

15.9 Head Injury

Theory

1. RFDS transfers patients from remote facilities to regional centres for CT scans to rule out intracranial bleeds post head injury. Urgent CT is indicated in the following situations: GCS <13 on initial assessment or <15 at 2 hours post injury, suspected open, depressed, or basal skull fracture, post traumatic seizure, focal neurological deficit, and more than one episode of vomiting. Delayed CT (<8 hours) is appropriate for a patient with LOC/amnesia plus one or more of the following: >65 years, history of clotting disorder or treatment with warfarin/NOAC, and more than 30 minutes of retrograde amnesia.
2. The aims of patient management in severe head injury are to identify and treat life-threatening injuries and prevent secondary brain injury. Most of the morbidity results from delay in diagnosis and treatment of an intracranial haematoma or from failure to correct hypoxia and hypotension. A single episode of SBP below 90mmHg is associated with a doubling of mortality. Early referral to a neurosurgical team improves outcome.

Pre-flight and In-flight Management

1. Pre-flight information and advice is directed at airway management (with cervical spine control), oxygenation, and correction of hypotension. Flights will usually be Priority 1 or 2, depending on facilities at the referring location and the severity of the injury. Any patient who may require intubation or other intervention must be doctor-accompanied.
2. Patients with open head injuries or pneumocephalus require sea level pressurisation. Whether sea level pressurisation is also required for patients with a fractured base of skull is controversial. Closed head injuries do not require pressurisation to sea level.
3. Assessment and resuscitation priorities are as per EMST guidelines. Difficulties with intubation should be anticipated early as manual in-line cervical spine stabilisation will be necessary. There may be significant facial injuries, foreign bodies in the airway and distortion of airway structures at laryngoscopy.
4. Intubation is indicated to protect the airway from aspiration, correct hypoxia, ensure normocapnoea, and to control the combative patient to facilitate CT scanning or transport. Patients with a GCS ≤ 8 have been shown to benefit from early intubation, but the above criteria may include patients with GCS 8–13 as well.
5. The induction agent chosen must not contribute to hypotension, Ketamine is a reasonable choice for haemodynamic stability, there is no evidence to suggest it or suxamethonium use results in raised intra-cranial pressure.
6. Deteriorating conscious state, development of focal neurological signs, papilloedema or Cushing's reflex (hypertension and bradycardia) are evidence of raised intracranial pressure and may be treated with:
 - a) intubation and ventilation to low to normal P_aCO_2 (35-40mmHg).
 - b) 30° head elevation (ensure also the internal jugular vein has not been kinked by turning the head)
 - c) Loosen cervical collar and replace ETT ties with adhesive tape
 - d) Hypertonic saline (HTS) 3% 3mL/kg over 10-20 min has replaced previous recommendation for mannitol. (Discuss with neurosurgeon first). See following instruction regarding make up of 3% saline from 20% saline.
 - e) Steroids are not useful in the management of acute head injury.
 - f) Ensure patient well sedated and paralysed

7. Hypotension must be corrected to maintain cerebral perfusion pressure (CPP). The MAP should be positioned to allow maintenance of CPP, ie A MAP of 70-90mmHg or a SBP of not below 90mmHg.
8. Ensure adequate monitoring through invasive arterial blood pressure, oxygen saturation and cardiac monitors, use of ET_{CO}₂ analyser, frequent ABG and blood glucose estimations, and hourly urine measure.
9. Maintain normoglycaemia.
10. Patients with open head injuries require antibiotic prophylaxis. Flucloxacillin 1G IV 6 hourly is recommended.
11. Anticonvulsant prophylaxis may be indicated in severe neurotrauma. Give phenytoin 15-18mg/kg IV over 30-60 minutes. Levetiracetam (Keppra) is a newer alternative used in some centres.

Hypertonic saline solution

20% saline is available at the base in 10mL ampoules.

First: Remove 56mL from a 500mL bag of 0.9% Saline to make 444mL

Then: Add 56mL of 20% saline to bag.

- This solution is now 3% saline. (257mmol in 500mL)
- This procedure must be checked by another person.

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16 EMERGENCY ANAESTHESIA AND VENTILATION

16.1 Indications for Intubation

Theory

1. One should always have a clear rationale behind a decision to intubate a patient and be aware that it is not a risk free procedure for the patient.
2. In the transport setting an elective intubation in a controlled environment before moving the patient is much safer than attempting to intubate in the uncontrolled environment of an aircraft or ambulance. Good judgement and an understanding of the likely course of the patients illness is required to avoid the dangers of an unplanned intubation.
3. Indications for emergency anaesthesia and intubation include;
 - a. Airway compromise, actual or anticipated
 - b. Respiratory failure eg. flail chest, pneumonia, asthma
 - c. Inability to protect airway due to depressed conscious level eg. head injury or poisoning
 - d. Severe cardiovascular instability eg. septic or cardiogenic shock
 - e. Last line management of behavioural disturbance
 - f. Humanitarian reasons
 - g. Facilitate controlled ventilation when managing raised intra-cranial pressure
 - h. Predicted clinical need likely to arise in course of transport
 - i. Facilitation of surgical or other procedure

Emergency anaesthesia is often conducted by infrequent intubators, safe practice relies on regular training or rehearsal, team work and a disciplined approach.

16.2 Conduct of Rapid Sequence Induction

Theory

Rapid sequence induction is intended to achieve a definitive airway rapidly so as to minimise risk of airway soiling and achieve rapid control of ventilation. The intent is to create the best intubating conditions possible.

Conduct of RSI requires a disciplined team approach with careful planning, role delineation and consideration of patient factors such as anatomy and pathology. (See [Modification of RSI for Special Circumstances](#)). Planning should factor into consideration difficult or failed intubation with a clearly articulated plan.

Patient assessment

The patient must be assessed as best possible for predictors of difficult intubation whilst remaining cognisant of the fact that many difficult intubations have no obvious predictors. All emergency intubations should be considered potentially difficult. A number of anatomical measures have been helpful in predicting difficulty, these may be summarised in the mnemonic LEMON.

- L** Look for anatomical indicators of difficult intubation; large tongue, protruding teeth, beard / moustache, large breasts
- E** Evaluate 3-3-2; measure mouth opening 3 fingers width, hyoid-mental distance 3 fingers width, thyro-hyoid distance 2 fingers width. Variations on these distances may predict difficulty.
- M** Mallampatti, in practice this may not be possible in the emergency setting as evaluation involves a cooperative seated upright patient.
- O** Obstruction, look for evidence of airway obstruction, injury (facial or soft tissue neck), masses, swelling, foreign bodies, scarring, stridor, dysphonia.
- N** Neck mobility, c-spine precautions, rheumatological conditions (RA, Ankylosing spondylitis, surgical fusion), previous radiotherapy.

Preparation – equipment

- The retrieval team should not be reliant on referring services to provide and maintain the equipment that may be needed for intubation.
- All members of the retrieval team are expected to be intimately familiar with the equipment carried, lack of familiarity with this gear is inexcusable and may result in a poor patient outcome.
- Set up of equipment should follow a standardised layout to assist in quickly finding the appropriate device when needed and to ensure nothing is missing. This equipment set-up is sometimes called a kit-dump.
- RFDS air way equipment is listed in this manual under Part 5 Standard Aircraft Minimum Equipment List; Airway and Breathing.
- A challenge and response check-list should include all the equipment required for intubation and failed intubation drill. Equipment should be checked and working.
- This preparation should include readiness for post-intubation; confirmation of tube position (ETCO₂ warmed up and ready to use), ventilator and circuit set up and ready to connect).

Preparation – patient

- Patient preparation includes positioning, pre-oxygenation, ensuring adequate monitoring and lines in place. Consideration should also be given to access to the patient, ideally 360° access.

- The optimal position for intubation is one in which the patient's external auditory meatus is aligned with the sternal notch in the vertical plane. This is also known as the ramped position, in obese patients this may require a number of pillows and towels positioned under shoulders and neck.

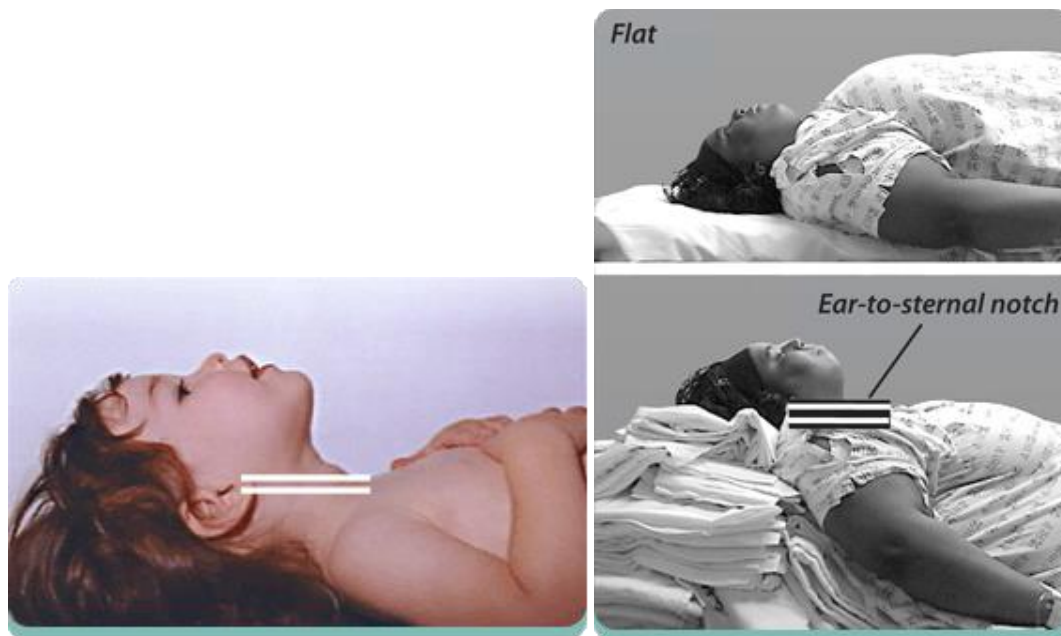


Figure 16.1. Optimal intubation position

- If cervical spine injury is suspected the ramped position is not possible, a person must be allocated the role of manual in-line stabilisation of the neck. This will allow the collar to be removed for intubation but still makes for a more difficult intubation than would otherwise be the case.
- The goal of pre-oxygenation is to maximise oxygenation and flush out nitrogen from the lungs and ensure a greater reservoir of oxygen available for gas exchange whilst apnoeic. Pre-oxygenation is generally achieved by spontaneous breathing high flow oxygen via a face mask, usually for a minimum of three minutes.
- Be aware that for effective pre-oxygenation with a bag-valve-mask apparatus a patient must be able to generate sufficient negative pressure to open the valve, for many patients this may be difficult and a non-rebreather mask will be better.
- A patient with ineffective breathing may need to be assisted to achieve adequate pre-oxygenation with assisted breaths applied via B-V-M with PEEP valve (with cricoids pressure in place) or via Non-Invasive Ventilation.
- In addition to pre-oxygenation the practice of applying high flow oxygen via nasal prongs to the apnoeic patient may buy further time for intubation prior to desaturation.

Preparation – personnel

- All personnel should be assigned specific roles and confirmation that they understand these roles be sought.
- Roles may include, depending on numbers available:
 - Intubator: Makes plan, executes intubation / airway procedures, maintains situational awareness. Runs check list with airway assistant.
 - Airway assistant: Runs check list with intubator, passes equipment and anticipates next step according to plan, monitors time and patient.

- Drug administration: Very explicit instructions must be given explaining what is in syringe, what volume is to be given (mark the syringe if necessary), ensure line free flowing and drugs do not flow back up into bag. Instruct regarding order of administration, speed and flushing.
- Cricoid pressure: May not be used, often obscures airway, of doubtful benefit, if used have low threshold for removal when difficulties occur. Ensure operator knows how to perform, when to apply and when to release.
- MILS (Manual In-Line Stabilisation): Ensure operator knows how to perform and is positioned such that will not interfere with access to airway, may be preferable with a caudal position.
- Scribe
- Runner

Preparation – drugs

- Ensure appropriate drug choices based on patient's pathology. (See [Anaesthetic Drugs](#)).
- Calculate and check doses and have drawn up and labelled.
- Have induction agent, paralytic and ongoing maintenance drugs drawn up
- Draw up and label rescue drugs eg. a vasopressor, atropine.

Table 16.1 Intubation Checklist

PLAN	Rapid Sequence Induction (RSI) indicated?	Check	
	Airway assessment completed?	Check	
	Modifications to standard RSI considered?	Check	
PREPARE PATIENT	Optimise patient position including 360° access where possible.	Check	
	Establish monitoring (BP, SpO ₂ , ECG) and ensure visible to team.	Check	
	Baseline BP and SpO ₂ and set to 3 minutely cycles.	Check	
	Oxygen mask tight, reservoir bag moving with ventilation.	Check	
	Connect nasal cannulae to patient and O ₂ .	Check	
	O ₂ supplies checked. Spare available.	Check	
PREPARE DRUGS & EQUIPMENT	IVI/DRUGS	Cannula connected to fluids, runs easily.	Check
		Spare cannula in situ.	Check
		Fentanyl dose _____ mcg _____ mLs	Check
		Induction agent _____ mg _____ mLs	Check
		Paralysing agent _____ mg _____ mLs	Check
		Rescue drugs.	Check
	LARYNGOSCOPE	MAC size _____ and bulb working.	Check
		Alternate blade size _____ and bulb working.	Check
	SUCTION	Suction working and positioned.	Check
		Back up suction available.	Check
	ET TUBES	Bougie size _____	Check
		Tube size _____	Check
		Tube cuff tested, connector secure.	Check
		Syringe for cuff.	Check
		Alternate tube size _____	Check
	BVM	BVM functional and connected to flowing oxygen.	Check
	CIRCUIT	Filter.	Check
		ETCO ₂ on and warmed up.	Check
	OTHER	Tube tie.	Check
		LMA / Video laryngoscope available.	Check
		Surgical airway kit available.	Check
	PERSONNEL	Plan B and C explained.	Check
		In-line immobiliser briefed.	Check
		Cricoid, ext laryngeal manipulation person briefed.	Check
	CHECKS COMPLETE. COMMENCING RSI @ _____		
	CONFIRM AIRWAY	Check ETCO ₂ trace on monitor.	Check
		Listen for air entry – Team leader verifies airway secure.	Check
	PREPARE FOR TRANSFER	Maintenance anaesthesia and paralysis for journey.	Check
Insert Guedel airway or other bite block.		Check	

Table 16.2 Immediate Intubation CheckList

IMMEDIATE INTUBATION CHECK LIST
OXYGEN
IV
DRUGS (induction agent and relaxant)
LARYNGOSCOPE
SUCTION
BOUGIE
ET TUBE (size)
SYRINGE (for cuff)
ETCO₂
BVM

Induction and Paralysis

- Induction agent and paralysis are given in pre-determined doses rapidly with generous flushes in between.
- If cricoid pressure is to be used it should commence as soon as there is loss of consciousness.
- If suxamethonium is used onset of paralysis will be indicated by fasciculation (this may be subtle)
- Do not ventilate the patient at this point.

Intubation and confirmation of placement

- Intubation should proceed promptly with a focus on maintaining oxygenation and prompt progression to failed or difficult intubation drill if not succeeding.
- Tube placement is confirmed by a continuous ETCO₂ waveform and seeing the tube pass through the cords.
- Both axillae and stomach should be auscultated in addition to checking ETCO₂ waveform.

Post-intubation management

(See [Packaging and Ongoing Management of the Ventilated Patient](#))

16.3 Anaesthetic Drugs

Induction agents

Thiopentone – dose 1–3mg/kg

- traditional gold standard for RSI due to rapid onset and predictable degree of anaesthesia
- main side effect is hypotension (can be overcome by combining smaller doses with an opiate such as fentanyl)
- beneficial in head injuries (lowers ICP; anticonvulsant)

Propofol – dose 0.5–2mg/kg

- profound respiratory depressant
- more hypotensive compared with thiopentone (therefore not suitable for most emergency inductions)
- useful as ongoing sedation for ventilated patient if plan is to awaken soon after admission

Ketamine – dose 1-2mg/kg

- dissociative anaesthetic (causes state of profound analgesia and anaesthesia where patient may appear awake)
- airway reflexes are NOT preserved at induction doses
- causes increase in sympathetic activity resulting in increased BP, increased ICP and bronchodilation
- indications: acute asthma, profound hypovolaemic shock (eg. AAA)
- contraindications: head injuries (relative), IHD

Fentanyl - dose 3µg/kg

- short-acting opiate; profound respiratory depressant
- useful in combination with other induction agents (allows smaller doses to be used, causing less hypotension)
- avoid in shocked patients who are relying on their sympathetic drive to maintain their BP as fentanyl abolishes this and can result in severe hypotension
- prevents the rise in ICP from laryngoscopy in head injured patients
- high doses can cause chest wall muscle rigidity and difficulty in ventilation(treat with suxamethonium)

Sedation agents.

Midazolam – dose 0.15mg/kg

- slow onset of action and hypotension has resulted in it **no longer being considered suitable for RSI**
- has amnestic and anticonvulsant properties
- useful in ongoing sedation of ventilated patient

Morphine – dose 0.1–0.2mg/kg

- sometimes used as an adjunct to other induction agents
- less reliable respiratory depression and suppression of airway reflexes, slow onset and hypotension has meant it is no longer recommended for RSI
- useful with midazolam as ongoing sedation of ventilated patient

Neuromuscular blockers

Suxamethonium – dose 1-2mg/kg

- non-competitive depolarizing neuromuscular blocker
- IV administration leads to fasciculations 10–15 sec
- maximum paralysis 30–60 sec
- return of spontaneous respirations 3–5 mins
- full ventilatory capacity 8-10 mins

Side effects:

- fasciculations leading to increased intragastric, intraocular & intracranial pressures (possible clinical significance)
- increased serum K⁺ (up to 0.5mmol/L in average patient; up to 5-10mmol/L in patients with burns or crush injuries >48 hrs, or those with NM disorders;
- patients with renal failure who are not hyperkalaemic can be given suxamethonium)
- bradycardia (especially children or repeated doses in adults)
- Scoline apnoea (congenital absence of pseudocholinesterase results in prolongation of paralysis (hrs) – not a contraindication in most patients ventilated for transport as usually ventilated longer than this)
- Malignant hyperthermia (genetic skeletal muscle abnormality triggered by inhalational anaesthetics and suxamethonium leads to muscle rigidity and breakdown, autonomic instability, hyperkalemia and acute renal failure. Often fatal.) Treated with dantrolene.

Rocuronium – dose 1-1.5mg/kg (in RSI); 0.15mg/kg (ongoing relaxation)

- competitive, non-depolarizing blocker
- indications as above but more rapid onset makes it an attractive option where suxamethonium contraindicated and rapid intubation conditions desirable.
- Intubating conditions in 60 sec.
- Duration 10-40 minutes. Sugammadex, used for rapid reversal exists but is currently not carried by RFDS.
- Preference for rocuronium over suxamethonium is a clinical decision based on a number of factors including patient issues, clinician experience and need to secure an airway by either oral or surgical means regardless.
- Minimal side effects.

Vecuronium – 0.1mg/kg (ongoing relaxation)

- competitive, non-depolarizing blocker
- indications: intubation in patients where suxamethonium contraindicated, ongoing relaxation in ventilated patient
- IV administration→ onset of paralysis 90 sec.

16.4 Difficult Intubation

Theory

1. In the emergency and retrieval setting the risk of a difficult or failed intubation is increased by the nature of the patients and the settings in which intubation may be carried out.
2. Some features that might suggest potential for difficulty can be assessed prior intubation however a great many difficult intubations are unpredictable.
3. All doctors should have a well rehearsed plan to manage a difficult intubation.
4. All doctors and flight nurses should be intimately familiar with the equipment carried by RFDS for management of a difficult airway.
5. Communication needs to be clear in a crisis. Commands must be addressed to individuals, heard then repeated back to ensure they were heard correctly.
6. Ensure that as a team leader you are able to listen to suggestions from your team and utilize the skills of all that are available.
7. PATIENTS DO NOT DIE FROM FAILURE TO INTUBATE, THEY DIE FROM FAILURE TO OXYGENATE.
8. OXYGENATION DOES NOT REQUIRE VENTILATION.
9. GET HELP EARLY.
10. There is no room for hesitation in a “Can’t intubate, Can’t oxygenate” situation. Decisive progress to a surgical airway will save lives.

Pre-flight and In-flight management

Assessment of the patient

1. History. Congenital or acquired airway problems (rheumatoid, ankylosing spondylitis, pregnancy). Trauma of face, neck, or larynx. Radiotherapy. Previous difficulties (ask patient, check note, medic alert etc.)
2. Examination
 - a) Anatomy – small mouth, receding chin, high arched palate, big tongue, bull neck, morbid obesity, large breasts.
 - b) Scarring, radiotherapy fibrosis.
 - c) Neck flexion.
 - d) Poor dentition (gaps to get blade stuck in, awkwardly placed teeth)
 - e) C-spine immobilization, dental wiring.
 - f) Beard hiding abnormalities
 - g) Tests
 - Inter-incisor gap – distance between incisors with mouth fully open (<3cm intubation more difficult)
 - Mandible protrusion – if can’t protrude lower incisors anterior to upper likely to be more difficult.
 - Mallampati - examine oropharynx with moth fully open, tongue out and no phonating, if unable to see uvula more difficult.
 - Thyromental distance – with next extended measure distance from tip thyroid cartilage to tip of mandible <6cm predicts 75% difficult laryngoscopies.

Preparation

- a) Position patient to your best advantage. Neck flexed, head extended. Pillow under shoulders. Obese patients ramped (external auditory meatus in line with manubrium.) If necessary lower the bed or stand on a box to get the best view.
- b) Prepare your equipment and assistants.
- c) Use of introducer or bougie at the outset. Have capnography attached to the BVM.

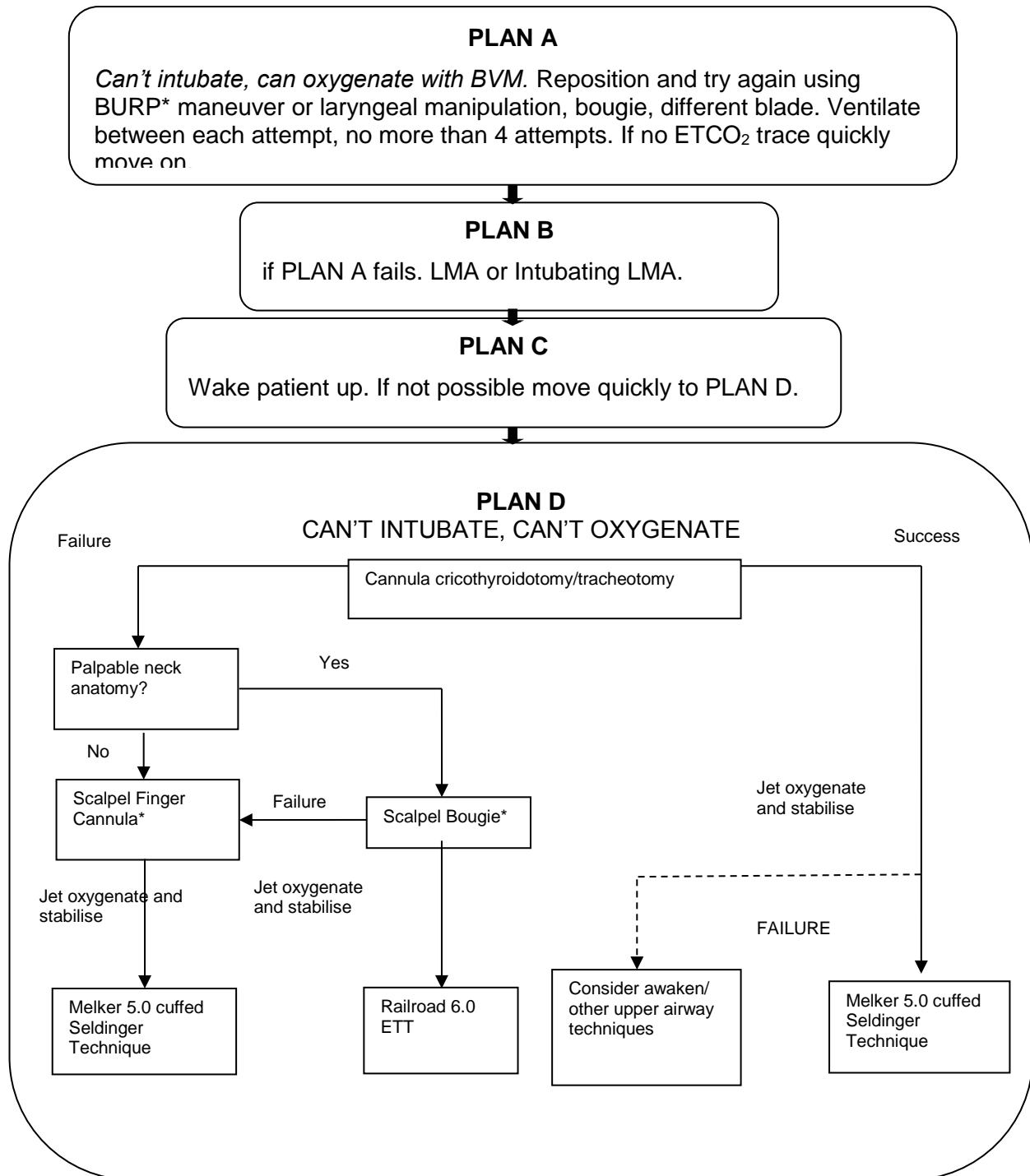


Figure 16.2. Difficult airway algorithm

- BURP – Moving the larynx by applying “Backwards, Up and to the Right Pressure”
- Scalpel Finger Cannula Technique – Make an 8-10cm caudal to cranial vertical midline skin incision then use blunt dissection with fingers of both hands to separate strap muscles and identify trachea. A 14G cannula is then inserted directly into the airway as per needle cricothyroidotomy technique. Jet oxygenation can now be provided to reoxygenate then the cannula can be used to guide the Seldinger wire of the Melker kit. (See Part 3 - Procedures Scalpel Finger Cannula Technique and Melker Cricothyroidotomy Conversion Technique).
- Scalpel Bougie Technique - Midline anatomy can easily be identified, stabilize with non dominant hand and make a horizontal incision through cricothyroid membrane. Without removing blade, rotate 90° and pull towards yourself creating a triangular window through which you insert a Frova bougie feeling for tracheal rings. Jet oxygenation can be provided via the hollow bougie or a size 6 ETT can now be railroaded over the top. (See Part 3 - Procedures Scalpel Bougie Technique)

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16.5 Modification of RSI for Special Circumstances

Theory

The aim of retrieval/prehospital airway management is to intubate the trachea without desaturation (<90%), hypotension or adverse effects on underlying pathological processes. Patients who are compromised prior to intubation or at risk for rapid development of hypoxia or hypotension may require increased resuscitation or peri-intubation care to achieve this goal.

Patients with impaired ventilation

Pre-oxygenation

- Pre oxygenation should aim to produce oxygen saturations of 95% or greater prior to commencing RSI with a staggered series of interventions to optimise pre-oxygenation.
- Ensure optimal *positioning* with patient ramped to 30-45° by elevating the head of the bed or using pillows to prop. Use a stool if this makes the patient too high for you to intubate.
- If sats less than 95% with NRBM and NP consider adding PEEP with the addition of a BVM with PEEP valve or NIV with F_IO₂ of 100%. Max out at 15cmH₂O PEEP or if PEEP causing adverse hemodynamic effects.
- Consider placing a gastric tube to *decompress the stomach* if this may be impairing ventilation
- If patient is unable to tolerate NIV consider small titrated doses of *ketamine to facilitate* pre-oxygenation.
- If bradypnoeic or hypoventilating commence *assisted ventilation* with BVM and attached PEEP valve +/- airway adjunct.
- Consider performing a rapid sequence airway, and placing an LMA to bag through the apnoeic period or gentle ventilation through the apnoeic period to prevent desaturation. This may be achieved using the ventilator on NIV setting.

Patients with haemodynamic instability

Resuscitate before you intubate.

Consider that loss of sympathetic tone with RSI may cause acute deterioration and hypotension.

- Ensure minimum of 2 large bore vascular access and optimise volume status.
- Control or minimise haemorrhage if possible
- Have short acting vasopressor drawn up and ready to use as boluses (adrenaline 10mcg/mL or metaraminol 0.5mg/mL)
- Commence vasopressor infusions prior to commencing RSI
- Establish continuous arterial BP monitoring (if clinically appropriate) prior to RSI
- Check and correct potassium/calcium, modify drug choices accordingly
- Fentanyl and ketamine for induction at a 1mg/kg dose
- Consider an increase muscle relaxant dose 2mg/kg for suxamethonium and 1.6mg/kg for Rocuronium.

Paediatric Patients

- Children have higher rates of complications and adverse events when undergoing emergency airway management than adults. Children under 12 months are at highest risk. Consider calling for expert help if available.

- *Positioning* for optimal airway patency is different for children. Neonates and infants may benefit from a rolled towel under the shoulders.
- Children require *higher mg/kg suxamethonium* dosing: 3mg/kg for neonate, 2mg/kg for children. Rocuronium dose is unchanged at 1.2mg/kg.
- *Needle crico-thyroidotomy is the surgical airway* technique of choice in children. Scalpel based techniques have been used successfully, however, and should be attempted if needle based techniques fail. Oxygen flow rate via the needle cric is 1L/min/year age up to a maximum of 15L/min.

Bariatric Patients

- Bariatric patients have decreased functional residual capacity and *desaturate faster* than non obese patients. They may experience a greater complication rate in out of operating theatre intubations.
- Back up head elevated position in vital in this group. In spinal precautions consider tilting the whole bed to obtain a head up position.
- Suxamethonium drug dosing is on total body weight and Rocuronium on ideal body weight.
- Propofol, Thiopentoin, Ketamine and Fentanyl induction dose should be based on lean body weight.⁽¹⁰⁾
- Lean body weight is a complex calculation and an online calculator may be used. If this is not available, you can calculate LBW as
Male LBW in kg = $(9270 \times \text{Wt (kg)}) / (6680 + 216 \times \text{BMI})$
Female LBW in kg = $(9270 \times \text{Wt (kg)}) / (8780 + 244 \times \text{BMI})$
- Ideal body weight is calculated as
Male IBW in kg = $50 + 0.91(\text{Ht in cm} - 152.4)$
Female IBW in kg = $45.5 + 0.91(\text{Ht in cm} - 152.4)$

Obstetric Patients

- Obstetric patients requiring airway management have impaired FRC and are at risk for more rapid desaturation. Large breasts may impede laryngoscope insertion into the mouth. Venous return may be impaired by the weight of the gravid uterus on the IVC in the supine positions. The tone of the lower oesophageal sphincter is reduced and there is a higher risk of regurgitation.
- Call for expert help if available
- Ensure a wedge is placed below the right hip to tilt the pelvis and displace the uterus off the IVC
- Consider disarticulation of the laryngoscope blade if insertion into the mouth is impossible. Insertion of the king vision may be particularly problematic with large breasts, consider an alternate video option if available such as a macintosh blade style device.
- Back up head elevated positioning will assist prevention of regurgitation, improve pre-oxygenation and may improve ease of laryngoscopy
- Post intubation aim for mild hyperventilation to a target $P_a\text{CO}_2$ of 30-35mmHg to maintain the physiological hyperventilation of pregnancy

Upper airway obstruction

- RSI is relatively contraindicated as risk of failure is high.

- A risk benefit analysis of transport to the nearest specialist anaesthetist vs local management must be made. The CC or OSD may provide support for this decision if able to be contacted.
- Nebulised adrenaline 5mg and IV dexamethasone 8mg (0.15mg/kg up to 0.6mg/kg in children) may be considered to decrease upper airway swelling
- Position upright and provide supplemental oxygen
- Consider alternate techniques such as awake intubation or nasal intubation with endoscopy if available.
- If RSI is undertaken the patient should be prepared for surgical airway prior to induction with full set up of equipment for Front of Neck Airway, preparation and marking of the cricothyroid membrane and if possible allocation of task to a second doctor as part of the airway plan.

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16.6 Packaging and Ongoing Management of the Ventilated Patient

16.6.1 Preparation and Planning for the Transfer of a Ventilated Patient

Theory

- Transfer of a ventilated patient is a time and resource intensive undertaking that requires significant coordination of equipment and resources
- Transfer is a high risk part of the patient treatment journey for the critically ill and must be undertaken with due care and planning.⁽¹⁾

Pre-flight Planning

1. All ventilated patients must have a doctor, flight nurse team.
2. No more than one ventilated patient to be carried on aircraft at one time. Exceptions may occur in mass casualty events or when using the "Lifeflight Jet" if a 2nd RFDS doctor is available and on board.
3. Priority will depend on diagnosis and patient's condition plus local resources. (e.g. ventilated trauma patient in small hospital may be Priority 1 whereas stable ventilated patient with overdose in regional hospital may be Priority 2 or 3).
4. Patients with time critical pathology should be notified to the pilot as requiring medivac flight status on the leg from referring location to receiving location.
5. RFDS doctor and flight nurse will usually go into the referring hospital to package patient for transport and escort patient to airport. This is especially important if patient is unstable, requires intubation or other procedures. However, if patient is time-critical and already prepared, the referring doctor *should be requested to bring the prepared patient to airport provided they have the skills and equipment to do so.*
6. Calculate oxygen requirements and ensure sufficient available, especially for long flights and Jet retrievals:

Flow rate x 1.5 journey time (min).

The Oxylog 3000 displays oxygen consumption in l/min, the Oxylog 1000 can be estimated at 8l/min for "air mix" and 15L/min for "no air mix". Non invasive ventilation can use very large amounts to compensate for leak (eg. 25L/min). When using ventilators add 1-2 L/min for driving gas.

A PC-12 aircraft carries approx 3000 litres plus 2 D cylinders (at 1600L each).

The jet carries 2 lifeport stretcher systems. Each of these holds 12,800L of O₂ (in 2 x 6,400L cylinders under each lifeport stretcher)(2)

C (490L) cylinders are used in oxyvivas and for transfer from aircraft to ambulance.

Table 16.3. Approximate Duration of O₂ Cylinders

Size	Flow Rate (L/min)						
	4	5	6	7	8	15	25
C	120	90	80	70	60	30	18
D	400	320	270	230	200	100	60

7. A vacuum mattress minimises spaghetti of equipment during multiple patient transfers and should be carried for all ventilated patients.

8. Ventilated patients require 2 persons (one a doctor) to escort them at all times. If stable the doctor can escort into hospital with a paramedic acting as the second escort. For unstable patients the flight nurse may be requested to accompany the doctor into hospital.
9. The arrival of a ventilated patient to the destination hospital requires the preparation of significant staff and resources. Early notification of transfer and communication during assessment with the receiving hospital should occur. The receiving hospital should be updated with an ETA on departure from the referring site and again on arrival at destination.

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16.6.2 Conduct of the Transfer of a Ventilated Patient

Theory

1. The handover of a critically ill patient is a period of risk in their clinical journey. At all times Team Leadership should be explicitly stated and the time of transfer of responsibility clear to all involved in the patient's care.
2. Intubated patients are at risk of extubation particularly during times of patient transfer between transport frames and hospital beds. This is potentially life threatening and must be immediately recognised and managed.
3. All ventilated patients by definition are critically ill and require careful attention to detail in supporting and monitoring all bodily functions.
4. The preparation of a ventilated patient for transfer requires significant cognitive workload, this has been distilled into a checklist to promote safe consistent practice. The checklist is conducted prior to ambulance departure from the referring hospital and on ambulance departure from the arrival destination airport.
5. Refer: [Indications for Intubation, Conduct of Rapid Sequence Induction Anaesthetic Drugs, Difficult Intubation, Modification of RSI for Special Circumstances, Table 16.4 Ventilated Patient Transfer Checklist, Ventilation Strategies.](#)

On arrival at referring destination

- All necessary equipment to perform an intubation and manage a critically ill patient should be taken into the hospital by the retrieval team.

At the referring hospital

- On arrival to the referring hospital the retrieval team should introduce themselves to the treating team in the room and enquire as to patient stability.
- If the patient is stable a "hands off" handover should take place from the treating team to the RFDS crew prior to the RFDS crew touching the patient or beginning to change over any equipment.
- Once handover has been conducted the RFDS Doctor accepts responsibility as the treating clinician for the patient. It is prudent to ask a member of the treating team (usually the resus nurse) to remain in the room and assist with further information and trouble shooting. Clear allocation of roles should be communicated.
- Once the RFDS team have accepted responsibility for patient management they should proceed with an initial patient assessment and document findings.
- Once the patient is stable on RFDS equipment and in RFDS care an ambulance for transport to the aircraft should be requested via RFDS Coordination Centre.
- On arrival of the ambulance the RFDS Doctor is responsible for directing transfer of the patient onto the ambulance stretcher.
- Once loaded on the stretcher the [Table 16.4 Ventilated Patient Transfer Checklist](#) is undertaken between the RFDS nurse and doctor team.

Initial Patient Assessment

Airway

- Grade of intubation
- ETT position (level at anatomical landmark), patency and secured (tape and tie)
- Cuff pressure or saline
- Confirm placement (clinically, ETCO₂ and/or CXR)

Breathing

- HME filter proximal to ETT with ETCO₂ sensor between HME and circuit
- Check ventilation – chest movement, auscultation, capnography wave form and S_aO₂
- Check ventilator settings – mode, F_iO₂, CO₂, tidal volume, minute volume, respiratory rate, peak airway pressure, mean airway pressure, PEEP and pressure support.
- Check previous ABGs if available

Circulation

- Assess haemodynamic values HR, Rhythm, 12 lead and NIBP / IABP
- Hb
- Assess vascular access – Minimum of 2 peripheral IVC, CVC, arterial ensure patent and secure. Identify spare / emergency access port.
- Check infusions – location (large bore for vasopressors and inotropes), concentration, rate and remaining volume
- Check IDC – size, patency, output (colour, clarity, volume and secured)

Disability

- Neurological assessment – pupil size and reactivity, consider possibility of awareness and adequacy of sedation
- Check position of OGT/NGT and placement – clinically, aspiration, litmus, air bolus or radiological and secured.

Environment and electrolytes

- Check temperature
- Check previous pathology – electrolytes, BSL, lactate and ABG

Transferring between vehicles

- Transferring the patient between hospital, ambulance and aircraft stretchers requires careful attention and a coordinated approach. All movements should be coordinated and controlled by the person at the head end who is responsible for ETT security.
- Ensure all RFDS equipment taken into the hospital is retrieved.
- Before transferring to any O₂ supply check contents are sufficient and supply is on. Constantly monitor O₂ availability. The Oxylog 3000® does not ventilate in the absence of a pressurised gas supply.
- After each movement review ABC and functioning of equipment and infusions.

In-flight Management

Vital signs and ventilation parameters should be monitored continuously.

Airway and Breathing

- Check and adjust cuff pressures using manometer prior to take off, on ascent, during flight and on descent. Record this on the patient record (if air in the cuff).
- Wave form capnography and oxygen saturations should be continuously monitored.
- If not contraindicated head up positioning improves ventilation and decreases the risk of passive aspiration and should be considered for ventilated patients.

- Check S_aO_2 and $ETCO_2$ against P_aO_2 and P_aCO_2 via arterial blood gas analysis at least once whilst on the transport ventilator.
- Salbutamol may be added to the ventilator circuit if required via an MDI aerosolisation device. Place as close as possible to the ETT (on the patient side of the HME filter) and dose on inspiration.

Circulation

- All Ventilated patients receive continuous ECG monitoring.
- Blood pressure may be monitored non invasively with an automated cycle set to 15 min cycle or more frequently if required, continuous invasive BP monitoring has advantages including the ability to monitor ABG results and electrolytes via the line in addition to real time monitoring or pulse and blood pressure.
- Hourly urine output measures should be recorded
- Central access is not necessary where patient care will be significantly delayed by the insertion of a CVC. Vasopressor infusions may be run through a dedicated and closely monitored large bore peripheral line. Longer transports may have increased benefit from CVC access and this should be considered, especially for expected transfer times of greater than 4 hours.

Drugs

- Ensure adequate supplies for duration of transport, check infusion pumps functioning correctly.
- Ensure timely delivery of ongoing intermittent drugs such as antibiotics
- Continuous infusion of sedation is preferable to intermittent bolus doses
- Continuous infusion or intermittent bolus of a neuromuscular blocker such as vecuronium may be used to compliment sedation, to avoid coughing and straining on tube during stimulating periods, and assist with ventilation. Consideration should be given to the risk of long term neuromuscular blockade (critical illness myopathy and longer ventilator dependence).

Disability

- Record pupil size and reactivity, consider possibility of awareness. Ensure pressure area and corneal protection.
- Monitor and correct BSL

Environment

- Monitor temperature (consider temperature probe inserted into oesophagus).
- Where appropriate warm with warming blanket (BARRIER EasyWarm®).
- NGT/OGT drainage, to reduce gastric distension and risk of aspiration and prevent splinting of diaphragm, which can reduce venous return (especially children).

Communication

- The receiving hospital should be updated with the patient status prior to departure or in flight. If urgent interventions are thought to be required on arrival (Straight to cath lab or theatre, emergency delivery or neonatal resus) the appropriate teams at the receiving hospital should be notified prior to or during flight.
- RFDS Coordination Centre should be notified of the ETA, the expected staff to escort in to the receiving hospital (Doctor only or doctor/nurse team) and the priority of the ambulance for the airport to hospital leg.

On arrival to Receiving Destination (airport)

- The RFDS doctor directs the transfer of the patient to the ambulance stretcher
- If a paramedic is taking over as the second escorting clinician they are briefed by the RFDS doctor as to the patient history, current treatment and anticipated complications during ambulance transfer. Roles in case of patient deterioration should be made clear.
- Conduct the pre departure checklist prior to ambulance departure
- Update the receiving hospital with an ETA prior to departure on whilst in the ambulance
- Consider carrying the escorting doctor drug bag and a bag/trolley for equipment recovery.

On arrival to Receiving Hospital

- Ensure that the ambulance staff know the way to the destination ward and have adequate access, otherwise request a hospital escort such as an orderly be provided.
- Ensure both oxygen and suction available
- If the destination ward is a long distance from the ambulance bay (FSH ICU, KEMH Birth Suite) and the patient is unstable consider diversion to the ED to allow for hospital staff to assist with stabilisation and intra-hospital transport.
- On arrival to the receiving ward the RFDS doctor continues to hold clinical responsibility for the patient until handover has occurred. Consider requesting a “hands off” period to allow handover either prior to transfer of the patient to the hospital bed or after transfer had been completed.
- Ensure that all RFDS equipment is retrieved from the patient and carried back with the Doctor to base.
- If blood was carried for the transport and not used, notify the receiving blood bank and request that the units be returned to stock.

Table 16.4 Ventilated Patient Transfer Checklist

EQUIPMENT		
Airway	Ventilator settings correct?	<input type="checkbox"/>
	Ventilator alarms set (including volume)?	<input type="checkbox"/>
	Sufficient battery power available?	<input type="checkbox"/>
	Oxygen-supply sufficient and turned on?	<input type="checkbox"/>
	BVM resuscitator with peep valve	<input type="checkbox"/>
	Intubation equipment (Plan A and B)	<input type="checkbox"/>
	Mapleson's C circuit or Ayers T-Piece	<input type="checkbox"/>
	Capnography connected and reading	<input type="checkbox"/>
	Stethoscope	<input type="checkbox"/>
	Suction available	<input type="checkbox"/>
	Circulation	Fluid/ Blood available
Monitoring on and alarms set		<input type="checkbox"/>
Defibrillator and pads available		<input type="checkbox"/>
Drugs	Intubation (sedative and paralytic)	<input type="checkbox"/>
	Emergency (push dose pressors, atropine)	<input type="checkbox"/>
	Adequate infusions and back up	<input type="checkbox"/>
	Infusions clearly labelled	<input type="checkbox"/>
Other	Intermittent drugs for during transport (eg Abx)	<input type="checkbox"/>
	Patient notes	<input type="checkbox"/>
	Clamps if needed (ICC)	<input type="checkbox"/>
	Lines and drains untangled and secure	<input type="checkbox"/>
	Vac mat suctioned and patient secured	<input type="checkbox"/>
PATIENT STATUS		
Airway / Breathing	ETT secure (confirm position at teeth / on CXR)	<input type="checkbox"/>
	Capnography waveform present	<input type="checkbox"/>
	Blood gas checked	<input type="checkbox"/>
	Correlate P _a CO ₂ with ET _{CO} ₂	<input type="checkbox"/>
Circulation	Hemodynamically optimised	<input type="checkbox"/>
	Rapid venous access point identified	<input type="checkbox"/>
	Infusions connected and running	<input type="checkbox"/>
Disability	Current neurological status (GCS/ Pupils)	<input type="checkbox"/>
	Current neurological status (GCS/ Pupils)	<input type="checkbox"/>
	Adequate restraints in place for transport	<input type="checkbox"/>
TEAM		
	Team leader identified	<input type="checkbox"/>
	Roles briefed	<input type="checkbox"/>
	Anticipate and plan for complications	<input type="checkbox"/>
	Prepare a structured handover	<input type="checkbox"/>

Table 16.4 Ventilated Patient Transfer Checklist (cont'd)

CARRIED EQUIPMENT CHECKLIST	
Perform upon leaving aircraft and leaving referring hospital	
Oxylog 3000 or 3000+	<input type="checkbox"/>
Test Lung and Charger	
Zoll X series monitor / defibrillator	<input type="checkbox"/>
Zoll Extras Box	<input type="checkbox"/>
Braun Syringe Drivers (minimum of 4)	<input type="checkbox"/>
BodyGuard Infusion Pump and giving set	<input type="checkbox"/>
I-STAT	<input type="checkbox"/>
Drug Box and Cold Drugs	<input type="checkbox"/>
Yellow ALS Bags:	
Intubation bag	<input type="checkbox"/>
Emergency airway kit	<input type="checkbox"/>
Long airway accessories (bougie) bag	<input type="checkbox"/>
Bag Valve Mask	<input type="checkbox"/>
Vac Mat	<input type="checkbox"/>
Zoll X charger	<input type="checkbox"/>
Patient Chart	<input type="checkbox"/>
Optional:	
EZ-IO	<input type="checkbox"/>
Blood	<input type="checkbox"/>
Ultrasound	<input type="checkbox"/>

16.7 Ventilation Strategies

Theory

- Two widely practiced ventilation strategies exist – the **lung protective strategy** (based on ARDSnet (ARMA Study)) and the **obstructive strategy**. Novel *modes* of ventilation that work in combination with these strategies are also being practiced in critical care.
- A strategy should be selected according to the patient's underlying pathology to minimise the risk of causing additional ventilator induced injury. If a patient is suffering from an obstructive problem (asthma, COPD, bronchiolitis), the obstructive strategy is recommended. For all other patients, use a lung protective strategy.

Pre-flight and In-flight management using the Oxylog 3000/3000 PLUS

Lung Protective Strategy

Aim for low tidal volumes ($V_t = 6\text{mL/kg}$ based on ideal body weight (IBW)) and titrate RR to achieve goal PCO_2 and pH. Adjust PEEP and $\text{F}_{\text{I}}\text{O}_2$ concurrently to achieve adequate oxygenation (see staircase recruitment manoeuvre and PEEP/ $\text{F}_{\text{I}}\text{O}_2$ charts).

Target plateau pressures (P_{plat}) $<30\text{cm H}_2\text{O}$.

Special Circumstances:

- **Head injury:** hypoxia and hypotension both worsen outcome. Excessive PEEP can result in hypotension and reduced cerebral perfusion pressure. PEEP = $5\text{cm H}_2\text{O}$ (default) adequate. Aim for low-normal PCO_2 ($35\text{-}40\text{mmHg}$). Nurse 30° head up.
Avoid excessive suctioning. Tape (not tie) ETT in place
- **Metabolic acidosis:** $\text{RR} \geq$ that which patient achieved, $\text{ETCO}_2 \leq$ patient achieved. Use blood gas results to further adjust V_t and RR. Lighten sedation to allow additional pressure supported patient breaths if possible ($\Delta\text{supp} = 10$, Trigger = 2). Starting PEEP = $5\text{cm H}_2\text{O}$ (default) adequate
- **Hypertensive APO:** start PEEP = $10\text{cm H}_2\text{O}$ and rapidly titrate up whilst rapidly titrating GTN IV infusion to target $\text{SBP} \leq 140\text{mmHg}$ (however, *beware PEEP $>15\text{cm H}_2\text{O}$* as can negatively affect left ventricular function, reduce preload and right ventricular filling)
- **Cardiogenic shock:** avoid high PEEP (can worsen hypotension)
- **Pregnancy:** start $V_t = 8\text{mL/kg IBW}$, RR 18-20 bpm. Aim for low-normal PCO_2 & normal pH. Nurse left lateral position
- **Obesity:** avoid excessive suctioning and disconnections. Recruitment needs to be followed by adequate PEEP ($10\text{-}15\text{cm H}_2\text{O}$). Consider prolonged inspiratory time, I:E ratio 1:1 - 2:1 (if not gas trapping)

Obstructive Strategy

Aim for $V_t = 5\text{-}8\text{mL/kg}$, low RR and long expiratory times with no/low PEEP (PEEP = 0 (asthmatic) or PEEP ≤ 5 (COPD)). Tolerate permissive hypercapnoea (as long as $\text{pH} > 7.1$). Patients usually need heavy sedation and opioid analgesia to blunt any hypercapnoeic reaction.

Specifically:

COPD/Asthma: Use largest endotracheal tube possible. Aim to minimise hyperinflation and rest respiratory muscles. Consider heavy sedation and paralysis.

Use a high inspiratory flow rate (achieves shorter inspiratory time) and a longer exhalation time to avoid breathstacking and volu/barotrauma. Expect (and may need to accept) high peak airway pressures due to high airway resistance. The plateau pressure (aim $\text{P}_{\text{plat}} < 30\text{cm H}_2\text{O}$) is more useful to monitor. Conduct an inspiratory hold manoeuvre to measure P_{plat} . If dynamic

hyperinflation is suspected (from ETCO_2 trace and flow waveform), disconnect the patient from the ventilator and manually decompress the chest (note: valid in the NON spontaneously breathing patient only).

Special Notes

- The following reference charts are recommended starting points only and should be modified depending on hourly ABG's and haemodynamics. These charts assume the patient is apnoeic and nursed at 30° head up.
- Either volume controlled or pressure controlled modes may be used, however, if an uncuffed tube is in place or in adult patients with significant and varying leaks, pressure controlled ventilation is recommended.
- **Staircase Recruitment Manoeuvre in Lung Protective Strategy** (facilitates alveolar recruitment): set $\text{F}_i\text{O}_2 = 0.4$ and $\text{PEEP} = 5$, then work up the ARDSnet PEEP- F_iO_2 Scale until desired S_pO_2 is reached.

Rapidly Deteriorating Patient

- **Remove from ventilator and bag ventilate.** Get a feel for the lungs
- **Check tube** – displacement, obstruction, dislodged
- **Check patient** – eg pneumothorax, (→ decompress)
- **Check ventilator and other equipment**

Table 16.5 Volume Controlled Ventilation with Draeger Oxylog 3000 PLUS



		Lung Protective Strategy (all other patients >1yo if cuffed tube)										Obstructive Strategy (COPD/asthma if cuffed tube >1yo)
Mode		VC (SIMV)										VC (SIMV)
Vt		6mL/kg IBW (see chart)										6mL/kg IBW (see chart)
RR		16-18 bpm then titrate to normal pCO ₂ / pH										6-8 bpm then examine Expiratory Flow Curves. If breath stacking, ↓ RR (min: 4 bpm), Permissive hypercapnoea (PH>7.1).
Pmax (alarm)		≥40cm H ₂ O (if alarms, follow instructions below)										≥ 40 H ₂ O (if alarms, follow instructions below)
F_iO₂ (%)	Titrate to S _p O ₂ of 88-95%	40	40	50	50	60	70	70	70	80	90	Minimal F _i O ₂ for S _p O ₂ 88-95%
PEEP (cm H₂O)		5	8	8	10	10	10	12	14	14	14	PEEP 0
I:E		1:1.5 (default)										≥1:4
Autoflow: ON		Slope :  (default)										Slope:  (default) le fast inspiration
Other		<ul style="list-style-type: none"> If high PEEP results in ↓BP, give fluids & inotropes keeping MAP >65mmHg (paeds check chart below) If Pmax alarms, check for patient agitation / tube obstruction. If not the cause, perform inspiratory hold manoeuvre – if Pplat >30cm H₂O, ↓Vt by 1mL/kg steps (to min 4mL/kg) 										<ul style="list-style-type: none"> Sedate +++++, paralysis for minimum duration possible (eg. transport phases only) If ↓↓BP & difficult to ventilate, disconnect tube & allow to expire stacked breaths If Pmax alarms, check for patient agitation / tube obstruction. If not the cause, perform inspiratory hold manoeuvre – if Pplat >30 cm H₂O, ↓Vt by 1mL/kg steps (to min 4mL/kg)

Table 16.5 Volume Controlled Ventilation with Draeger Oxylog 3000 PLUS (cont'd)

Height	5'0"	5'2"	5'4"	5'6"	5'8"	5'10"	6'	6'2"	6'4"
Vt women (6mL/kg IBW)	276	295	330	360	385	415	440	470	490
Vt men (6mL/kg IBW)	305	320	360	385	415	440	470	490	520

Table 16.6 Pressure Controlled Ventilation Draeger Oxylog 3000 PLUS

RECOMMENDED FOR ALL UNCUFFED TUBES



	Lung Protective Strategy	Obstructive Strategy
Mode	PC SIMV+	PC SIMV+
Vt	Can't be set- see P _{insp}	Can't be set – see P _{insp}
RR	See chart and titrate to normal pCO ₂ /pH	1/3 normal RR – see chart, then check expiratory flow curves. If breath stacking, ↓ RR by further 20%. Permissive hypercapnoea (pH>7.1)
P_{max} (alarm)	≥40cm H ₂ O (if alarms, follow instructions below)	≥40cm H ₂ O (if alarms, follow instructions below)
F_iO₂ (%)	Titrate to S _p O ₂ of 88-95% 40 40 50 50 60 70 70 70 80 90	Minimal F _i O ₂ for S _p O ₂ 88-95%
PEEP (cm H₂O)	5 8 8 10 10 10 12 14 14 14	5 (default)
P_{insp}	Start at 20 then titrate to Vt (6mL/kg IBW) - see chart	Start at 20 then titrate to Vt (6mL/kg IBW) - see chart
I:E	1:1.5 (default)	≥1:4
Autoflow: ON	Slope :  (default)	Slope:  (default) ie fast inspiration
Other	<ul style="list-style-type: none"> If high PEEP results in ↓BP, give fluids & inotropes keeping SBP as per chart below (paeds check chart below) If P_{max} alarms, check for patient agitation / tube obstruction. If not the cause, perform inspiratory hold manoeuvre – if P_{plat} >30cm H₂O, ↓Vt by 1mL/kg steps (min 4mL/kg) 	<ul style="list-style-type: none"> Sedate +++, paralysis for minimum duration possible (eg. transport phases only) If ↓↓BP & difficult to ventilate, disconnect tube & allow to expire stacked breaths If P_{max} alarms, check for patient agitation / tube obstruction. If not the cause, perform inspiratory hold manoeuvre – if P_{plat} >30cm H₂O, ↓Vt by 1mL/kg steps (min 4mL/kg)

Table 16.7 Age and Weight Modifications

Age/BW	RR (Lung Protective)	RR (Obstructive)	Vt (6mL/kg)	SBP
Term/3.5kg	40-60 bpm	13-20 bpm	20mL Note min Vt on paed circuit is 50mL, must hand ventilate or use paed ventilator	≥50mmHg
3 months/6kg	30-50 bpm	10-16 bpm	36mL Note min Vt on paed circuit is 50ml, must hand ventilate or use paed ventilator	≥50mmHg
6 months/8kg	30-50 bpm	10-16 bpm	48mL Note min Vt on paed circuit is 50mL, may need to hand ventilate or use paed ventilator	≥60mmHg
1 year/10kg	30-40 bpm	10-13 bpm	60mL	≥65mmHg
2 years/13kg	20-30 bpm	7-9 bpm	78mL	≥65mmHg
4 years/15kg	20 bpm	7 bpm	90mL	≥70mmHg
6 years/20kg	16 bpm	6 bpm	120mL	≥75mmHg
8 years/25kg	16 bpm	6 bpm	150mL	≥80mmHg
10 years/30kg	16 bpm	6 bpm	180mL	≥85mmHg
12 years/40kg	16 bpm	6 bpm	240mL	≥90mmHg
14 years/50kg	16 bpm	6 bpm	300mL	≥90mmHg
17 years/70kg	16 bpm	6 bpm	420mL	≥90mmHg

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7. Tables (taken from the website above – Own the Oxylog 3000!):
8. Table 1. Nickson C. Own the Oxylog 3000! [Internet]. Australia: Life in the Fast Lane; 2011 [cited 2017 Feb 05]. [Table], Volume controlled ventilation with draeger oxylog 3000 PLUS; [about 1 screen]. Available from <https://lifeinthefastlane.com/own-the-oxylog-3000/>
9. Table 2. Nickson C. Own the Oxylog 3000! [Internet]. Australia: Life in the Fast Lane; 2011 [cited 2017 Feb 05]. [Table], Pressure controlled ventilation with draeger oxylog 3000 PLUS; [about 1 screen]. Available from <https://lifeinthefastlane.com/own-the-oxylog-3000/>
10. Table 3. Nickson C. Own the Oxylog 3000! [Internet]. Australia: Life in the Fast Lane; 2011 [cited 2017 Feb 05]. [Table], Age and weight modifications; [about 1 screen]. Available from <https://lifeinthefastlane.com/own-the-oxylog-3000/>
11. *NOTE: the author of this website (Dr C. Nickson) acknowledges on the LITFL website the above Tables1-3 were created by Dr George Douros, an Emergency Physician from the Austin Hospital in Melbourne, Australia*

16.8 Paediatric Considerations

Theory

1. Attention to differences in paediatric anatomy, physiology and psychology is required for the safe induction, intubation and ventilation of children.
2. Anatomic differences in infants and young children which may impact airway management include a high anterior larynx, large tongue, floppy epiglottis, large occiput, short trachea and the cricoid being the narrowest part of the airway.

Strategies to help overcome some of these differences include:

- a. using a straight laryngoscope blade in under 6 month olds for picking up the tip of the epiglottis (lift it up and forward)
 - b. positioning the child with a towel/IV fluid bag under their shoulders
 - c. avoiding hyperextension of the neck and avoiding pressing on soft tissues of the floor of the mouth when applying a face mask (keep fingers on bony parts)
 - d. use of CPAP with Ayre's T-piece
3. In children, the impact of an over distended stomach from mask ventilation is significant. Early decompression of the stomach is essential to successful ventilation.
 4. A short trachea means that flexion or extension of the head can result in either right main bronchus intubation or complete extubation. The head and neck should be immobilized to avoid this. The tube should be fixed to the maxilla rather than the mandible. A guedel airway may help splint the tube.
 5. Physiological differences of importance for paediatric ventilation include a lower functional residual capacity and increased oxygen consumption (so become hypoxic more quickly) and small, relatively fixed tidal volumes relative to body size 6 – 10mL/kg (making children at high risk of IPPV induced barotrauma).
 6. Pharmacokinetics of many drugs vary with age. Doses (per kg) may differ to adults because of greater sensitivity and slower drug metabolism (up until six months old, then differences in drug metabolism are less significant). Doses may also need to be reduced for those with altered conscious level or haemodynamic instability.

PRE INTUBATION:

Atropine (20 micrograms/kg IV) to prevent bradycardia associated with suxamethonium and laryngoscopy. It also dries up secretions.

INDUCTION /SEDATION Agents:

Propofol	2.5-3.5mg/kg IV	Midazolam	0.1-0.2mg/kg IV
Thiopentone	2-5mg/kg IV	Fentanyl	1-2 micrograms/kg IV
Ketamine	1-2mg/kg IV		

MUSCLE RELAXANT Agents:

Suxamethonium	2mg/kg IV	Rocuronium	0.6-1.2mg/kg IV
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7. Useful formulae:

- **ETT size (>1yo): age/4 + 4 (uncuffed) OR ETT size (>2yo) : age/4 + 3.5 (cuffed)** or size of nostril or little finger. In all cases, have a size above and a size below the expected available.
- **ETT length at lips (oral) cm: age/2+12.** ETT's are marked with a black line to guide insertion to appropriate depth (black line sits just below vocal cords)

- **Weight: 0-12 months** **weight (kg) = (0.5 x age in months) + 4**
 1-5 years **weight (kg) = (2 x age in years) + 8**
 6-12 years **weight (kg) = (3 x age in years) + 7**
- It should be appreciated that smaller diameter endotracheal tubes (ETTs) used in children are associated with higher resistance to flow. Any further reduction in tube diameter eg due to kinking or secretions will therefore have an even more pronounced effect for smaller tubes and may dramatically compromise ventilation.

8. Cuffed ETTs are now recommended for those size three and above, however, some caution needs to be heeded. Inflation of the cuff should be reserved as a means of compensating for a leak that is interfering with ventilation when higher pressures are required. **Even an uninflated cuff pressure can reach >30cm H₂O at altitude.** High volume, low pressure cuffs should minimize any risk of tracheal trauma however care needs to be taken to only inflate the cuff to the point where the leak is abolished and no more.

The use of a cuffed tube helps eliminate need for tube changes and difficulties ventilating with a large leak around the tube. A cuffed tube may also be less likely to extubate or migrate down the right main bronchus with movement of the head.

If handed over a patient with an uncuffed ETT already in place, the decision to change to a cuffed one will be a matter of clinical judgment and experience after assessing the adequacy of ventilation and degree of leak.

9. Use air in the ETT cuff so the pressure can be closely monitored and adjusted. Maintain the cuff pressure 20 – 30cm H₂O. Check the pressure during ascent, at the top of the climb, during descent and on landing. The impact of cuff expansion at altitude is greater than for the adult.
10. Neither the Oxylog 1000 nor the Oxylog 3000 are paediatric ventilators. Therefore, careful attention must be paid to the adequacy of ventilation. For children under 15kg in particular, there are significant challenges such that in some instances manual ventilation may be preferred.

For best results:

- closely monitor chest excursion (hand on chest), ETCO₂, S_pO₂ and ABG's
- minimise dead space (no catheter mount or other extraneous connectors in the circuit)
- use a paediatric heat moisture exchange (HME) filter

In the exceptional circumstance that an Oxylog 1000 may need to be used, a leak modification has been made to allow for smaller tidal volumes (see *Paediatric Leak Attachment* guideline).

- The Oxylog 3000 PLUS enables ventilation with much smaller tidal volumes and uses a dedicated paediatric circuit. This circuit can deliver tidal volumes of 50-250mL.

After switching the ventilator on, select "Disposable paediatric hose" (see Figure 16.3).

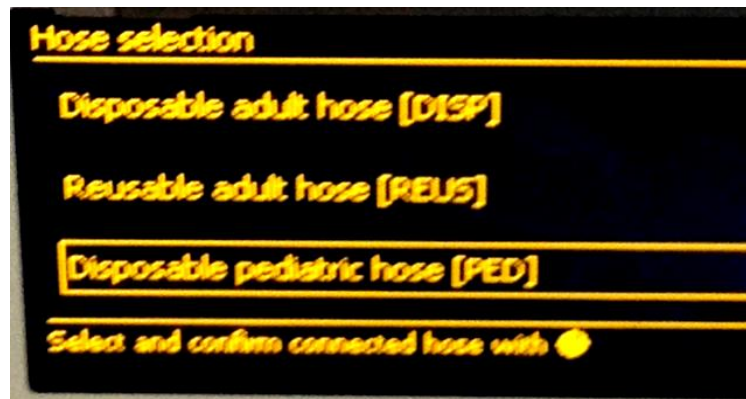


Figure 16.3 Oxylog PLUS Adult vs. Paediatric Hose Selection Menu

The designated paediatric circuit is designed to have reduced dead space and low compliance. It is coloured blue and has a number of additional differences.

Caution - if the end cap dislodges, the circuit will not work.

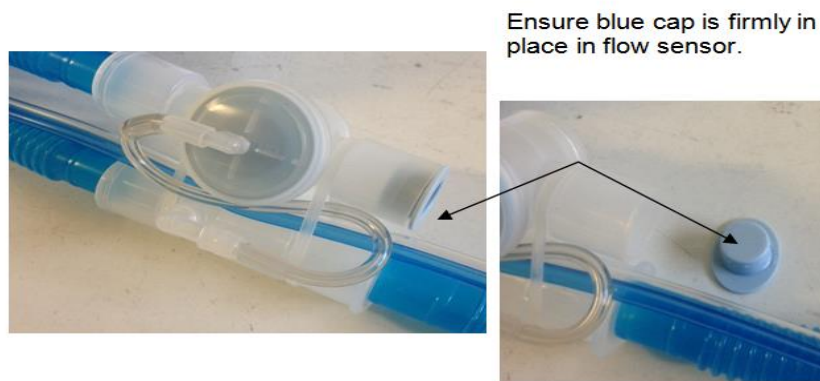


Figure 16.4 Paediatric Circuit Showing End Cap

The flow sensor tubing goes directly onto the ventilator. There is no intermediate plug.



Figure 16.5 Flow Sensor Tubing Connections

Additional dead space can be eliminated by use of a minimum volume HME filter (Drager) and correct positioning of the ETCO₂ cuvette (use an Oxylog 3000 Plus with a specific paediatric cuvette rather than the Zoll ETCO₂ cuvette).

Limit dead space even further by not using a catheter mount (Cobb's connector) in the circuit.



Figure 16.6: Paediatric HME

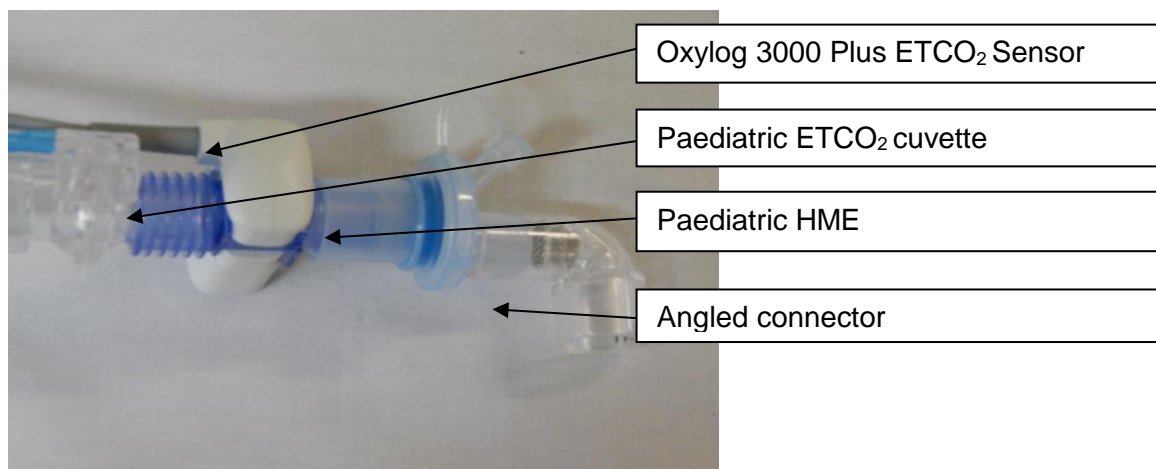


Figure 16.7 Paediatric Circuit Assembly for Oxylog 3000 Plus

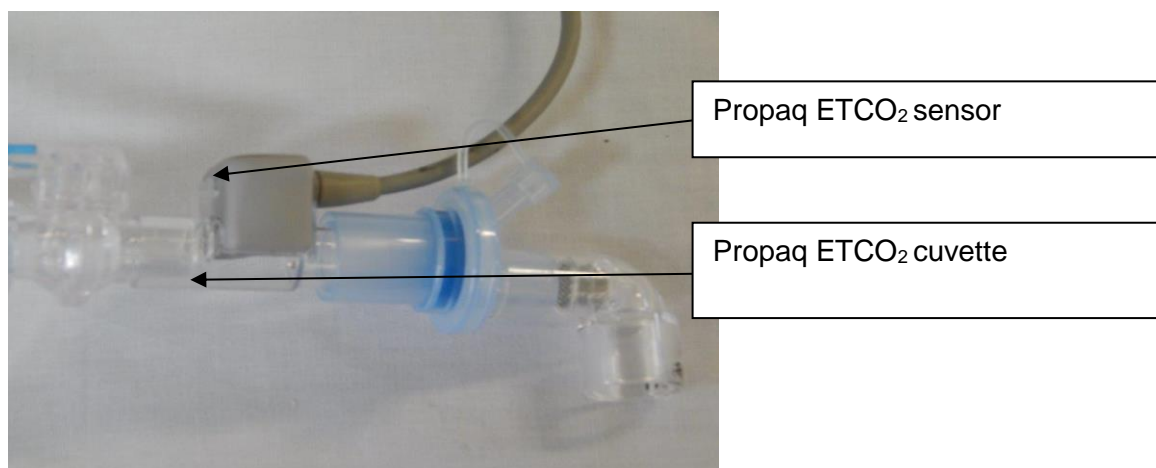


Figure 16.8 Paediatric Circuit Assembly for Oxylog 3000

11. Either volume controlled or pressure controlled ventilation mode can be used in children. Pressure controlled ventilation is recommended in the case of an uncuffed ETT. This mode compensates for air leak around the ETT but not changes in lung compliance or bronchospasm. Volume controlled ventilation allows for changes in lung compliance but can generate harmful high peak airway pressures.
12. Initial ventilation settings should take into consideration any physiologic derangement and underlying patient pathology. Further adjustments should then be made based on capnography, serial arterial blood gases and haemodynamics.

Of note, although lung protective, low tidal volume ventilation is supported in adult acute respiratory distress syndrome and premature infants, this strategy has not been proven to be superior outside these two groups. It is recommended children commence ventilation on tidal volumes $V_t = 6\text{mL/kg}$, however, clinical circumstances may warrant a higher or lower value.

Not dissimilar to adults, conditions resulting in severe airway obstruction, such as childhood asthma, may be managed using an obstructive ventilation strategy, where lower respiratory rates and longer expiration times are recommended.

Permissive hypercapnia and mild respiratory acidosis (pH 7.20-7.30) is also acceptable in the ventilated paediatric patient, with the exception of patients who are particularly sensitive to elevated $P_a\text{CO}_2$ or acidosis (those with raised intracranial pressure, pulmonary hypertension, cardiac dysfunction or sickle cell disease).

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16.9 Paediatric Leak Attachment

Description

Cylindrical aluminium connection with a small hole drilled through one wall. The hole is sited between ridges to prevent accidental obstruction. The device has a 22mm female connection at one end for connection to the ventilator and a 15mm female/22mm male connector for connection to the circuit.

Theory

1. This device was produced for use with the Oxylog 1000 ventilator. It is not required for use with the Oxylog 3000 or 3000 PLUS ventilator.
2. At a set rate of 30 breaths per minute and the lowest minute ventilation setting, the tidal volume delivered by the Oxylog ventilator is approximately 100mL. This limits use of the ventilator to infants of approximately 10kgs or greater.
3. Insertion of a 'deliberate' leak into the circuit allows delivery of smaller tidal volumes. Using this adaptor, Princess Margaret Hospital staff (Perth, WA) have successfully ventilated infants down to 4kgs.
4. The volume of gas leaked will be determined by the airway pressures and inspiratory time.
5. The device is recommended for use when ventilating infants less than 10kgs. It is the responsibility of the medical practitioner caring for the infant to ensure safe use of the device (with appropriate ventilator, circuit and settings) and adequacy of ventilation.

Technique

1. The device is inserted between the ventilator and patient circuit.
2. As with all infant mechanical ventilation, a ventilation rate is set and then the minute ventilation increased gradually from the minimum setting until adequate ventilation is achieved, gauged by degree of chest expansion, airway pressure, pulse oximetry and capnography. Beware rising pCO₂ resulting in increasing acidosis.
3. The device does not remove the need for frequent re-assessment of the patient and adequacy of ventilation and readjustment of parameters as required.
4. Small infants between 4-10kg may be better managed hand ventilated with either a Laerdal bag/valve mask (self-inflating) or T-piece, depending on the experience of the flight doctor.

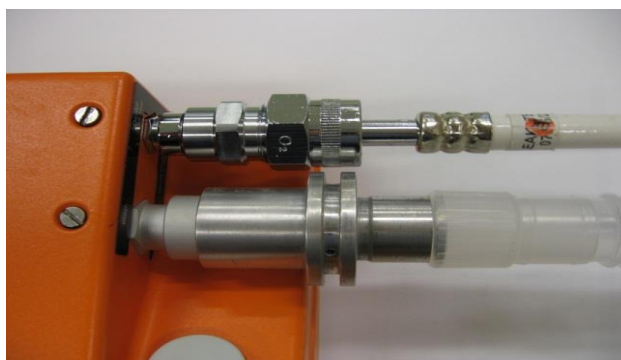


Figure 16.9: Paediatric Leak Attachment

References

1. Prepared by: Dr D. McConville, RFDS Western Operations, Port Hedland Base.
2. Reviewed by: Dr A. Duncan, ICU, Princess Margaret Hospital, Perth.

16.10 Non-Invasive Ventilation

Theory

1. In selected patients, non-invasive ventilatory support may prevent the need for intubation and mechanical ventilation. Complications of failed intubation, ventilator acquired pneumonia, tracheostomy and respiratory muscle wastage are avoided and the patient can continue to communicate. Positive pressure reduces the work of breathing and increases functional residual capacity by recruiting collapsed alveoli. Improvements in lung compliance can also be gained.
2. Left ventricular function can be improved by reduction in preload and afterload.
3. Two forms of NIV can be delivered with the Oxylog 3000: CPAP (continuous positive airway pressure) and BIPAP (biphasic positive airway pressure). CPAP is preferred for the management of acute pulmonary oedema whereas hypoventilatory respiratory failure (eg. from COPD) may benefit from BIPAP or CPAP with pressure support.
4. Two forms of NIV can be delivered with the Hamilton T1 ventilator NIV (CPAP) and NIV-ST (BiPAP). The Hamilton T1 has the added advantage of being able to continue ventilation if oxygen fails using its internal ceramic turbine.
5. Patients suitable for transport with NIV must be carefully selected as failure will expose patient and clinician to the risks of in-flight intubation.

Pre-flight and In-flight Management

1. Consider the opportunity for NIV when assessing the flight request. Patients already undergoing NIV should prompt consideration of using this technique for ventilatory support. The technique is likely to be less suitable for longer flight times as risk of failure increases with time.
2. Prepare to go in to the referring hospital, take the ventilator and NIV mask.
3. Time in the hospital is required to establish if treatment will work (at least ½ hour). Does the patient tolerate it, do parameters such as blood gases improve, is patient likely to become fatigued? NIV may not be a good option with restricted pilot hours.
4. Gas consumption during NIV is greater than that for IPPV (eg. up to 30L/min). Have you got enough oxygen?

Patient Selection

Contraindications

1. Not fully conscious or cooperative.
2. Risk of, or actual, airway obstruction or deterioration in conscious state.
3. Facial abnormalities, trauma, recent surgery or burns.
4. Suffering from excessive secretions, vomiting or bowel obstruction.
5. Having a high oxygen requirement or suffering life threatening hypoxia.
6. Profoundly acidaemic.
7. Haemodynamically unstable, suffering dysrhythmias or other severe co-morbidities.
8. Pneumothoraces (unless ICC in situ).
9. Recent upper GI surgery.
10. HACOR (HHeart rate, Acidosis, Consciousness, Oxygenation, Respiratory rate) score >5 after 1 hour of NIV is indicative of failure of NIV

Table 16.8 HACOR Scoring System

Parameter	Score	
HR	<120	0
	>121	1
pH	>7.35	0
	7.3-7.34	2
	7.25-7.29	3
	<7.25	4
GCS	15	0
	13-14	2
	11-12	5
	<10	10
P _a O ₂ /F _i O ₂	>201	0
	176-200	2
	151-175	3
	126-150	4
	101-125	5
	<100	6
RR	<30	0
	31-35	1
	36-40	2
	41-45	3
	>46	4

Indications

1. Acute pulmonary oedema.
2. Obstructive sleep apnoea.
3. Acute exacerbation of COPD.
4. Ventilator weaning.
5. Respiratory failure in immunocompromised (e.g. Neutropaenic) patients at high risk of ventilator acquired pneumonia.
6. Other acute respiratory failure where no contraindications.
7. Chronic respiratory failure e.g. neuromuscular disease where it is desirable to avoid intubation as weaning would be difficult.

Complications

1. Mask intolerance (25%)
2. Skin damage.

3. Gastric distension and aspiration. (Routine gastric decompression is not indicated however.)
4. Patient may still become obtunded and lose airway.
5. Sinus pain, nasal congestion.
6. Raised intraocular pressure.
7. Raised intracranial pressure.
8. Hypotension if hypovolaemic.

Ventilator set up Oxylog 3000

1. Use face mask and harness and connect to ventilator hose.
2. NIV can be delivered in CPAP and PCV modes on the ventilator. In NIV mode mask leakages will be detected and compensated and included in measured values for Vt and MV.
3. Switch on NIV by pressing Settings key, then scroll to page 2/2. On NIV line, change to ON and confirm.
4. Biphasic Positive Airway Pressure (BIPAP) can be delivered using NIV in the PCV mode. This is like giving CPAP at two alternating pressures.
5. Pressure support (a gas flow triggered by inspiratory effort to a set pressure) can be provided using the ASB (assisted spontaneous breathing) function in either BIPAP or CPAP.

Ventilator set up Hamilton T1

1. Ensure checks for tightness and flow sensor have been done and that circuit and expiratory valve are correctly attached.
2. Select the MODES tab and choose from the two options NIV (for CPAP) or NIV-ST (for BiPAP).
3. Select the CONTROLS function and adjust settings as described bellow.

Tips to aid patient compliance

1. If patient able, allow the patient to hold the mask initially until used to it, then apply harness.
2. Start with lower pressures and titrate up, the pressure should make the work of breathing easier rather than result in the patient fighting it. Provide an antiemetic.

BIPAP – Oxylog 3000

For hypoventilatory respiratory failure (e.g. acute exacerbation COPD)

- Set PCV
- Turn NIV on
- I:E ratio 1:2
- PEEP = 4cm H₂O
- P_{insp} = 10cm H₂O
- Titrate F_iO₂ to S_aO₂ >90%
- Adjust Trigger to maximise synchronisation with the patients breathing.
- Repeat ABG at 30 minutes
 - i. If PCO₂ decreased by 10-20% then PEEP = 4cm H₂O, P_{insp} = 16 cm H₂O

- ii. If PCO_2 decreased by $<10\%$ then $\text{PEEP} = 6\text{cm H}_2\text{O}$, $\text{Pinsp} = 20\text{ cm H}_2\text{O}$
- iii. If PCO_2 rising or clinically no improvement consider intubation.

For acute pulmonary oedema

- Set PCV
- Turn NIV on
- I:E ratio 1:2
- $\text{PEEP} = 8\text{cm H}_2\text{O}$
- $\text{Pinsp} = 10\text{cm H}_2\text{O}$
- Commence F_iO_2 100%
- Adjust trigger to maximise synchronisation with patients breathing.
- Repeat ABG at 30 minutes
 - i. If no improvement clinically and with ABG consider intubation.
 - ii. Titrate PEEP to $10\text{cm H}_2\text{O}$ and Pinsp to $15\text{cm H}_2\text{O}$

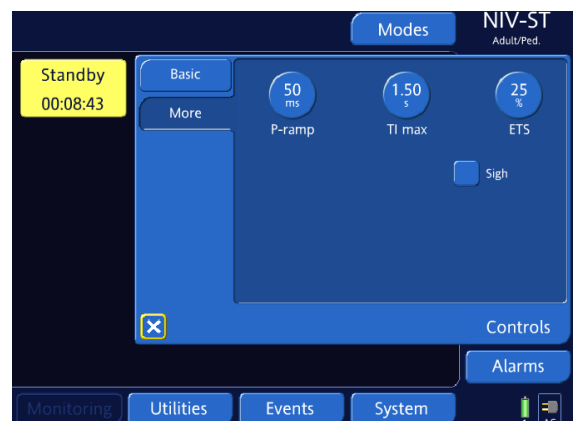
If no improvement after 1 hour consider intubation pre-flight.

BiPAP for hypoventilatory respiratory failure – Hamilton T1

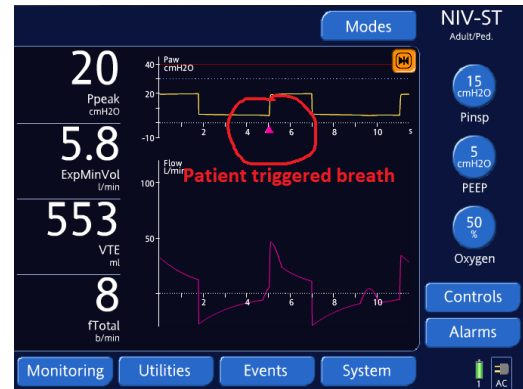
- Select NIV-ST
- Open CONTROLS, select Basic tab
 - $\text{Pinsp} = \text{IPAP}$, start at $10\text{cm H}_2\text{O}$
 - $\text{PEEP} = \text{EPAP}$, start at $5\text{cm H}_2\text{O}$
 - F_iO_2 start at 30%
 - Set rate for back up ventilation at 12/min
 - Set TI at 1-2 sec
 - Start flow trigger at 5l/min



- Start Pramp (speed of gas flow) at 50ms, may need to be slower for small frail patient eg. 70ms
- Set TI max at 2sec
- Set ETS (expiratory trigger sensitivity) at 25% (of peak inspiratory flow), increase this if flow curve indicates patient trying to breathe out before this.
- MONITOR patient for use of accessory muscles and increase Pinsp stepwise until patient appears improved, expect tidal volumes will increase and respiratory rate will fall as patient blows off CO_2 .
- Next look at PEEP - is the patient making efforts that are not sensed i.e. are they unable to trigger breaths? Increase PEEP 1 cm at a time until synchronous (most people will be ok between $5\text{-}8\text{cm H}_2\text{O}$ unless severe obstructive sleep apnoea who requires high PEEP).



- Tidal volumes may appear large, provided patient triggering these breaths DO NOT be tempted to reduce P_{insp}. PATIENT TRIGGERED BREATHS ARE INDICATED BY A RED TRIANGLE.
- If the tidal volumes fall and there are no red triangles the patient is not triggering breaths, are they apnoeic or obtunded? Intubate!



CPAP – Oxylog 3000

For acute pulmonary oedema

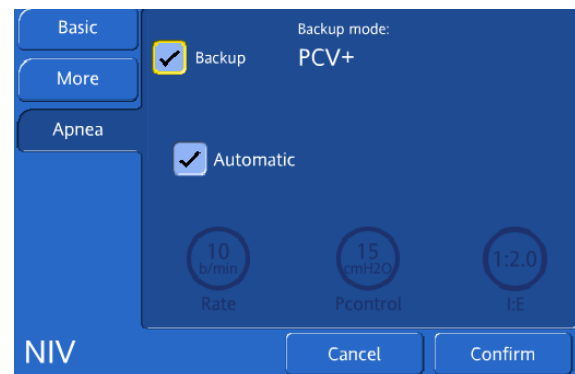
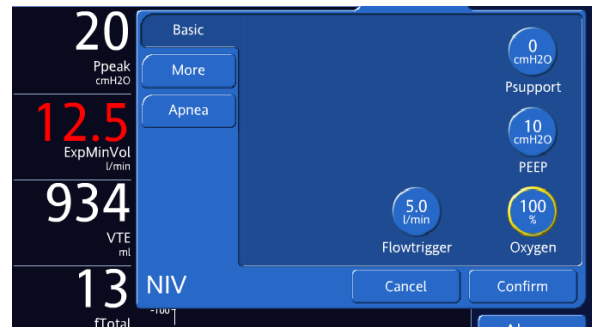
- Set CPAP
- Turn NIV on
- I:E ratio 1:2
- PEEP = 10 cm H₂O
- PS = 0
- Commence F_iO₂ 100%
- Repeat ABG at 30 min and assess patient clinically.
 - i. If no improvement consider intubation
 - ii. Titrate PEEP to effect (may need 15-20cm H₂O)

For hypoventilatory respiratory failure

- Set CPAP
- Turn NIV on
- I:E ratio 1:2
- PEEP = 4 cm H₂O
- PS = 15 cm H₂O
- Titrate F_iO₂ to S_aO₂ >90%
- Adjust trigger to maximise synchronisation with patient breathing.
- Repeat ABG at 30 min.
 - i. If no improvement consider intubation
 - ii. Titrate pressure support (ASB) to effect

NIV (CPAP) on Hamilton T1 for Acute Pulmonary Oedema

- In MODES choose NIV (not NIV-ST)
- In CONTROLS set P support to 0
- Set PEEP to 10
- Set F_iO_2 to 100%
- In MORE ensure Pramp of 50ms
- In APNOEA Ensure Backup is set to PCV+ Untick the backup and automatic boxes if you need to change these settings.
- Titrate F_iO_2 down to 50% by 10% increments.
- When comfortable reduce PEEP by 1cm increments until at PEEP = 5cm H_2O . If pressure wave form dips to 0 this implies PEEP is lost and work of breathing will increase.
- If no loss of PEEP when giving a PEEP of 5, and no increase in work of breathing, may consider weaning to HFNC if available. Choose flow of 10L/min greater than peakflow on CPAP. Note: in practice this may not be achievable in flight.



If no improvement after 1 hour consider intubation pre-flight.

References

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16.11 High Flow Nasal Cannula Therapy

Description

This therapy is a means of delivering high flow humidified oxygen via purpose-specific nasal prongs. RFDS carry the Airvo™ 2 by Fisher & Paykel, which is a purpose-built device for delivering this therapy.

Theory

1. Despite the increasing popularity of this modality it is still a relatively new treatment and evidence of its benefit is still limited.
2. It is a form of non-invasive respiratory support used to allow oxygen or an air/oxygen mix to be humidified and delivered at high flows. (up to 60L/min)
3. The proposed mechanisms for its effects include: Dead space washout, decreased nasopharyngeal resistance resulting in improved compliance, variable amounts of PEEP resulting in alveolar recruitment, and lower dilution of the administered gas with room air
4. There is some evidence that use of HFNC can reduce rates of progression to invasive ventilation and its associated complications. Observed physiological benefits include increased S_aO_2 , reduced pCO_2 , reduced respiratory rate, reduced heart rate and improved dyspnoea score
5. A decision must be made pre-flight about continuing this therapy versus ceasing and using face mask oxygen or committing to ventilating the patient.
6. Indications:
Bronchiolitis where there is hypoxia and mild to severe respiratory distress despite standard oxygen therapy.
Asthma, pulmonary oedema, acute respiratory failure
Pre-oxygenation prior intubation
7. Contraindications:
Blocked nasal airway eg. choanal atresia
Nasopharyngeal surgery or trauma
Pneumothorax
Fractured base of skull
Airway obstruction of any cause
Altered level of consciousness

Pre-flight and In-flight Management

1. In the majority of cases the patient will already have been commenced on high flow nasal oxygen by the referring hospital.
2. If the patient has been deteriorating despite HFNC, consideration should be given to intubating for transfer. The patient should be able to tolerate a prolonged period off highflow (e.g. the length of transfer between the hospital and airstrip) in case of equipment failure etc. This is a similar decision making process to taking a patient on other forms of NIV such as CPAP or BiPAP.
3. After initiating highflow nasal cannula therapy if the patient does not begin to improve after a 20 minute period, escalation to an alternative therapy should be implemented.
4. Ensure that you are carrying sufficient oxygen for the duration of the transfer. When transferring adults the oxygen consumption may be high. Using the Airvo 2, the maximum oxygen consumption will be what you are delivering through the aircrafts oxygen flow meter (e.g 15L/min x2). The remainder of the gas flow will be intrained room air.

5. For operating and set-up and power supply issues in aircraft and ambulance (See [Part 3 of this manual Procedures - Airvo™ and High Flow Nasal Oxygen Therapy](#))
6. The Airvo™ 2 does not have an inbuilt battery and therefore requires an external power source. When transferring from hospital into the ambulance, and from the ambulance into the aircraft, the Airvo™ 2 will not work. Oxygen can be delivered through the nasal prongs or via a facemask from a cylinder for these short periods. If the patient cannot tolerate these short periods off highflow then consideration should be given to intubating them for transfer.
7. These patients should always be assessed in hospital prior to transport. This will allow the device to be warmed up on mains power prior to use and a decision made regarding HFNC vs. Intubation.
8. The device and humidification chamber must be heated and the ambulance engine on prior to commencing use via an inverter in the ambulance.
9. Consider the need for a sea-level cabin if the patient oxygen requirement is high.
10. Flows are given at 1 – 2 L/kg/min. Maximum rate of flow using the Airvo™ 2 is 60L/min. F_iO_2 is titrated to the patient's target oxygenation. Using the Airvo™ 2, the F_iO_2 is controlled by adjusting the rate of oxygen delivery via the oxygen flow meter. Note that at very high flow rates there will be a maximum percentage of F_iO_2 which you can deliver based on the maximum output of the oxygen flowmeter/s.
11. Only the Airvo™ 2 has so far been assessed for RFDS use. Any consideration regards using another HFNC device would require escalation to DMS and aviation.
12. Monitor S_aO_2 , RR, HR and work of breathing.
13. Regularly check patency of cannula and condensation, water level in humidifier tubing and chamber. Ensure the cannula place no pressure on nasal septum or nares. Suction nose as required.
14. Observe for abdominal distension.
15. A rapid deterioration of S_aO_2 or marked increase in work of breathing should raise immediate suspicion of pneumothorax.
16. Discuss the case with receiving the hospital consultant to ensure appropriate reception for patient.

References

1. Roca, O et al. Current evidence for the effectiveness of heated and humidified high flow nasal cannula supportive therapy in adult patients with respiratory failure. *Critical Care* 20:109 April 2016

16.12 Tracheostomy Management Guideline

Theory

Background

A tracheostomy is a surgical tract is fashioned between the skin and tracheal lumen, in which a tracheostomy tube sits. Whilst tracheostomy patients are infrequent, half of all airway-related deaths or brain damage in critical care are a result of tracheostomy complications¹. Systems and training designed to prevent and respond effectively these incidents have been demonstrated to reduce airway related morbidity and mortality.

The anatomy of a laryngectomy is different, where the airway is no longer connected to the mouth/nose and the patient's airway can only be accessed via the tracheal stoma in the front of the neck (not via the mouth).

Equipment

Tracheostomy tubes come in several variations. Most adult males have a size 8, most females a size 6. Figure 1 outlines some of the features a tracheostomy may have. Most tracheostomies will have an inner cannula present, which can easily be removed, cleaned and replaced in event of a blockage. In a *Shiley*® brand tracheostomy tube (seen in figure 1) the inner cannula must be inserted to enable connection to a breathing circuit/ self inflating bag. Some patients will have valves to aid speaking, or 'swedish nose' humidification filters. In obese patients an adjustable length tube may be used; the locking mechanism must be properly secured to ensure the tube does not migrate out of the trachea or into a bronchus.

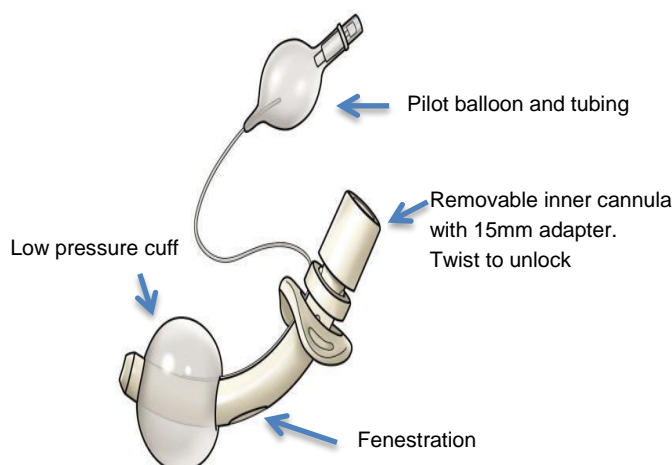


Figure 16.10: A cuffed, fenestrated Shiley® Tracheostomy tube. Adapted from Fong²

Complications

90% of tracheostomy complications occur >1week post insertion. The most common complications are bleeding, obstruction and dislodgement. 1 in 50 will develop chronic tracheal stenosis which may make airway intubation challenging.

Table 16.9 Tracheostomy Complications³

Short Term	Long Term
Bleeding	Tracheo-innominate fistula
Dislodgement	Tracheoesophageal fistula
Obstruction	Tracheocutaneous fistula
Pneumothorax, pneumomediastinum	Tracheal stenosis (2%)
Infection	Tracheomalacia

Crisis Management

An internationally recognised approach to dealing with a tracheostomy crisis is outlined in Figure 16.11. An App and guidelines are available from www.tracheostomy.org.uk

1. Filters, valves and inner cannula can be removed in a crisis to simplify the airway device and are easily replaceable.
2. If you cannot pass an appropriate diameter suction catheter beyond the length of the tracheostomy tube then the tube is either obstructed or no longer in the trachea.
3. Deflating a cuff may partially restore an upper airway.
4. The algorithm recommends removal of the tracheostomy tube at the point where you have demonstrated that the tracheostomy tube no longer provides an 'airway'. Removal of the tube may restore an airway via the upper airway or the stoma. As the latter can close over a period of hours, tracheostomy dilators can be used to 'hold open' the stoma.
5. "Mask" ventilating via a tracheal or laryngectomy stoma can be achieved using a size 3 classic LMA or as the 'mask' placed over the neck.
6. In a mature tract another tracheostomy tube, Melker or small ETT can safely be placed to 'secure' the airway. Caution needs to be taken to avoid endobronchial intubation, only insert an ETT just beyond the cuff. Ideally a fiberoptic scope and ET_{CO}₂ would be used to confirm placement of the new airway.
7. Standard transoral airway manoeuvres may be attempted, especially if the upper airway is patent. A gloved hand can obstruct the tracheal stoma to aid oral bag-mask-ventilation.

Preflight Assessment of the patient with a tracheostomy

Information to gather as part of PFA for any patient who has a tracheostomy insitu

- Indication for tracheostomy
- Patency of upper airway (Could I use normal trans-oral airway techniques in a crisis?)
- Tracheostomy insertion date and technique (<10 days = immature tract which would collapse if tube is removed/dislodged)
- Tracheostomy size, brand (eg: Shiley's uncuffed size 8 or Portex cuffed size 6)
- The presence of inner cannulae or valves (inner cannulae are a major safety feature which should be present).

Equipment to request be transported with the patient (may be sourced from referring hospital who ideally should have this at patient bedside)

- Spare tracheostomy tube of same model/size AND a tube a size smaller
- Spare inner cannula compatible with existing tube

- Tracheostomy dilators
- Suction catheters of appropriate size

If the reason for transfer is related to the tracheostomy

- What is the problem? Threatened airway? Bleeding?
- What has been done so far? Which airway (ENT) surgeon has been consulted, what was the advice?
- If threatened airway – consider the algorithm in figure 2. Interventions may need to be done prior to RFDS arrival. A fiberoptic scope may be useful in confirming the problem/location of tracheostomy tube.
- Ensure ETCO₂ monitoring is available inflight using the Zoll ETCO₂ inline device which will connect to tracheostomy. Have the Mapleson C circuit available during flight to assess ventilation via tracheostomy.
- Given the airway may be threatened and difficult to rescue this would usually be tasked as a P1 doctor.

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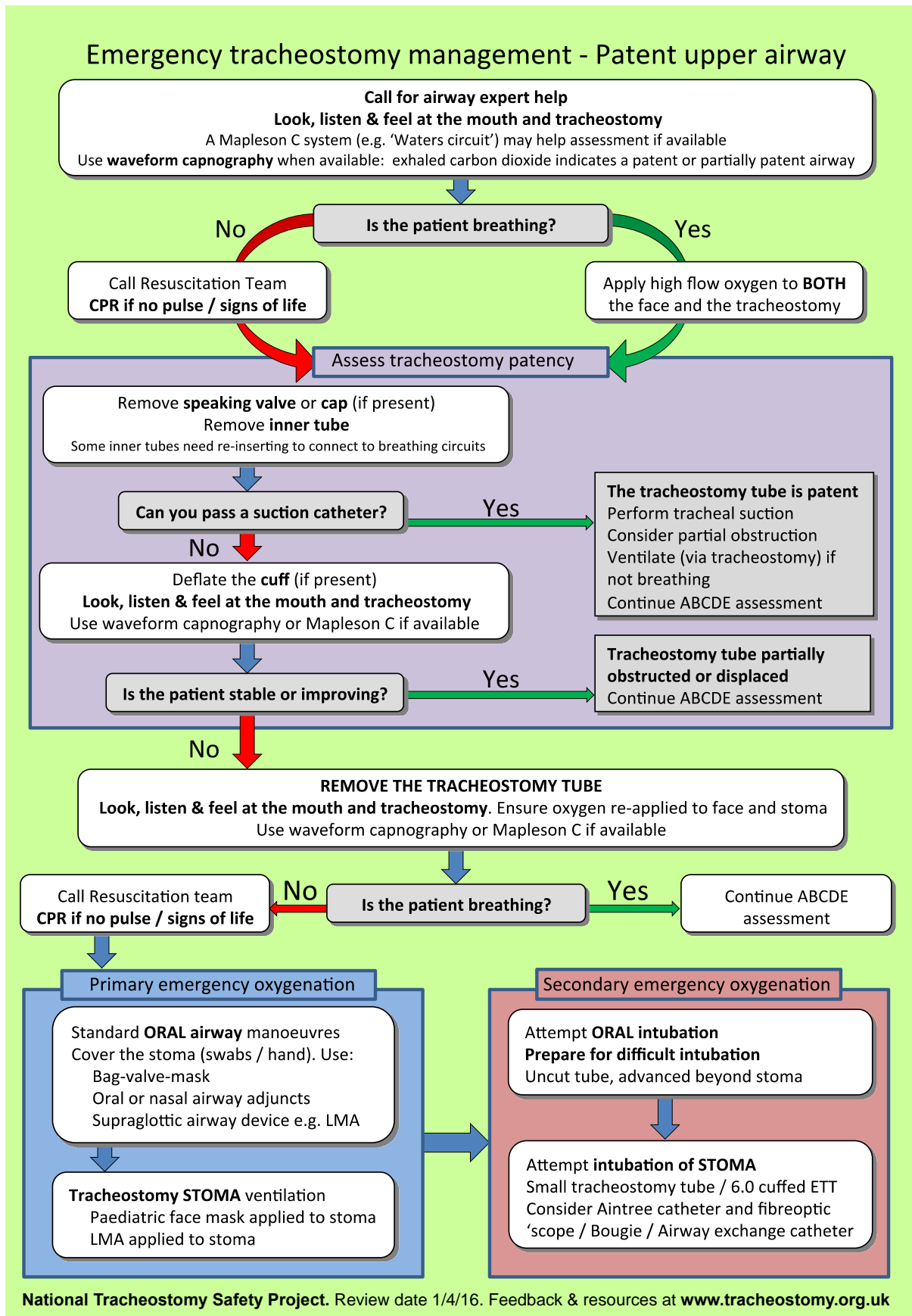


Figure 16.11 Emergency Tracheostomy Management

17 OCCUPATIONAL & ADMINISTRATIVE

17.1 Occupational Exposure to Blood and Bodily Fluids

Theory

1. HIV, Hepatitis B and C may be transmitted by significant exposure to blood or other body fluids.
2. Prevention is the mainstay of protection, so standard infection control practices must be adhered to.
3. Risk of transmission is dependant of the type of injury sustained. A thorough risk assessment of each exposure must be performed by an RFDS medical officer.
4. Those exposed to a source positive for a blood-bourne virus must be referred to an infectious diseases expert or clinical immunologist.

Risks

1. Risk of Hepatitis B infection carries the highest risk after exposure to a positive source (1-31%). Hepatitis B vaccine is advised for at risk staff (Nurses, Doctors, Pilots and Engineers); this vaccine has a 90% rate of protection after 3 doses.
2. Risk of Hepatitis C transmission after needle-stick injury from a positive source is 2-8%. Transmission from mucous membrane exposure is rare.
3. Risk of HIV transmission after percutaneous exposure from a positive source is 0.3% and 0.09% from mucous membrane exposure.
4. High risk injuries are:
 - i. Deep injury from a device visibly contaminated with blood.
 - ii. Injury associated with a hollow bore needle.
 - iii. Source patient has late stage HIV or high viral load.
 - iv. Source patient with Hep B who is HBeAg +ve, HBV DNA detectable, high viral load.
 - v. Source patient with Hep C who is HCV RNA PCR detectable

Procedure following injury or exposure

1. **First aid.** *If skin is exposed* the area should be washed well immediately with soap and water. If water is not available, use 60-90%alcohol hand cleanser (such as located near the red IV roll in the aircraft).

If the injury is to mucous membranes (eyes, mouth etc) rinse thoroughly with water or normal saline for at least 30 secs. If mouth contact has occurred, spit out then rinse several times.

2. Report the incident to an RFDS doctor immediately. Notify the doctor directly if on the flight, or by satellite telephone or radio, irrespective of your location. RFDS doctor should follow these guidelines:
 - a. Perform a **risk assessment** (based on history of the incident, knowledge of the patient)
 - b. Arrange **baseline blood tests** from source and recipient after informed consent.
 - c. **Counsel** recipient (regarding risk, required follow-up, precautions.)
 - d. Seek advice or arrange **referral** to infectious diseases or immunology expert(the immunology registrars at RPH, FSH and SCGH are available on call all hours via the switch board of the respective hospitals)

- e. Complete a **clinical incident report** (Notify Director of Medical Services or Assistant Director of Medical Services immediately).
- f. Seek consent of recipient to **forward follow-up results** to the office of the Director of Medical Services.
- g. **Workers compensation report:** complete notification for a work-related injury.

Risk Assessment

Table 17.1 Risk assessment for exposure to Bodily Fluids

Non Parenteral exposure (low risk)	Intact Skin
Doubtful exposure (low risk)	<ul style="list-style-type: none"> • Superficial (not bleeding) intradermal injury with device or needle thought NOT to be contaminated with bodily fluid. • Contamination of prior wound with substance other than blood. • Mucous membrane contact with substance other than blood.
Possible exposure (low to moderate risk)	<ul style="list-style-type: none"> • Superficial (not bleeding) intradermal injury from device or needle thought to be contaminated with blood or body fluid. • Prior wound contamination with blood • Mucous membrane contamination with blood.
Definite exposure (moderate risk)	<ul style="list-style-type: none"> • Skin penetrating injury with needle contaminated with blood or bodily fluid. • Injection of <1mL of blood or bodily fluid. • Laceration caused by visibly contaminated instrument. • In lab setting inoculation with HIV, HBV, HCV +ve tissues.
Massive exposure (high risk)	<ul style="list-style-type: none"> • Blood transfusion • Injection >1mL blood or bodily fluid • Parenteral exposure to lab specimens containing high titre of virus.

Medical Management

Table 17.2 Medical Management for Exposure to Bodily Fluids

<p>Source HIV positive</p>	<ul style="list-style-type: none"> • Immediate referral to immunologist for advice re PEP. Truvada is available from regional Hospitals. • PEP is best started asap and within 72hrs. • Expect immunologist to advise on risk of infection, signs and symptoms, PEP effectiveness, advice of pregnancy, breast feeding and co-morbidities. • Repeat testing at 6 and 12 weeks. • Provide ongoing counselling.
<p>Source Hep C positive</p>	<ul style="list-style-type: none"> • No prophylactic treatment is available. • Refer to clinical microbiologist or immunologist with Hep C expertise. • Repeat bloods, ALT HCV RNA PCR @ 4 , 8, 12 wks. • HCV ab @ 3 and 6 months • If become HCV Ab +ve or elevated ALT arrange for HCV RNA testing and possible antiviral treatment • Provide counselling.
<p>Source Hep B positive</p>	<ul style="list-style-type: none"> • If immune, no further action • Non-immune- see post exposure prophylaxis • Repeat LFT at 6 and 12 wks.HBsAg @ 12 and 24 wks • HBsAb @ 4-6w post vaccination or 4-5 months if post HBIG.
<p>Source status unknown, or high risk but negative</p>	<ul style="list-style-type: none"> • If high risk injury, treat as for positive source. • NB: It is not possible to test the sharp.
<p>Source negative for blood bourne virus</p>	<ul style="list-style-type: none"> • Offer repeat blood tests at 3 months.

Hep B PEP for the Non-immune

1. Unvaccinated
 - If source HBsAg +ve, give HBIG within 72 hrs and initiate Hep B vaccination within 7 days and at 1 and 6 months post the first dose.
 - If source is unknown, manage as above.
2. Previously vaccinated.
 - If adequate immunity, no treatment.
 - Non-responder (had 3 doses and re-immunised with 3 doses but still no response) should have a dose of HBIG within 72 hours.
 - Response to previous immunisation unknown, test anti Hep B Ab's, if < 10IU/L give 1 dose of HBIG within 72 hours and initiate Hep B vaccination within 7 days.

Risk Counselling

The nature of the injury and the status of the source must be ascertained in order to give accurate advice. Consider transmissibility information in "Risk Assessment" given at the start of this guidance.

Behavioural Counselling

Hep C exposure

- May not donate blood, plasma, tissues or semen during the follow-up period of 6 months.
- Do not need to modify sexual practices, avoid pregnancy or refrain from breast feeding.
- Continue standard precautions with work practices.

Hep B exposure in non-immune

- If high risk injury may not donate blood, plasma, tissues or semen for 6 months. Should avoid pregnancy until outcome known.
- Continuation of breast feeding and sexual activity will depend on immune status of baby or partner.
- Work practices may need to be modified according to the nature of the work. (see DOH Policy for Health Care Workers with BBV infection)

HIV exposure

- For 12 months may not donate tissues, blood, plasma, breast milk or semen.
- Sexual abstinence or protected sex (condoms) for a minimum of 3 months.
- Avoid pregnancy until 3 month surveillance is complete
- Do not share needles, razors, toothbrushes.
- Cover open wounds with waterproof dressings
- Continue standard precautions with work practices.

References

1. Department of Health, Western Australia. Operational directive Number: OD0641/15, dated 18 December 2015. Management of Occupational Exposure to Blood and Body Fluids in the Health Care Setting.
2. NHMRC. Australian immunisation Handbook (2013) 10th Ed

17.2 Deceased Patients

Theory

1. The death of a patient at any stage from pre-flight assessment or consultation through to admission at a receiving hospital must be recorded by filing a clinical incident form, this allows for accurate mortality reporting and where necessary appropriate compilation of records for coronial inquests.
2. All doctors are expected to know when and how a patient must be referred to the coroner, when it is acceptable to fill out a death certificate and how to fill out same.
3. RFDS aircraft generally should not be tasked to retrieve deceased persons as this makes the asset unable to respond to other emergencies.
4. The RFDS Director of Medical Services (or nominated deputy) must be notified at the time of death.

Patients to be referred to the coroner

- Deaths as a result of trauma, violence, criminal action, suicide.
- Death appears unexpected or unnatural.
- Deaths where the cause is not definitely known.
- Deaths where medical mismanagement is suspected.
- Deaths where you have not been the treating doctor in the most recent illness.
- Deaths where the doctor is unwilling to complete a death certificate.
- Death during or due to anaesthetic.
- Death during care (e.g. wards of the state) or custody, whilst detained under mental health act.

To refer a patient to the coroner either call the "Coronial Investigation Unit" (Police) or for remote areas the local police. The police are responsible for custody of the body, they may transport the body themselves or commonly arrange the government contracted undertaker to do so.

If a patient dies in flight, request operations staff contact the "Police Coronial Investigation Unit" (9267 5700) or local police to notify them of a sudden death. It should be requested that the aircraft be met to take over custody of the deceased. If there is no medical officer on board arrangements should be made for a medical officer to meet the aircraft. A medical officer must certify life extinct in the observation and treatment chart (this is not a death certificate merely documenting that the patient is dead). All lines and tubes should be left in situ, copies of all documentation should be made for the police or their contracted undertaker. Permission should be sought from the police to remove the patient from the aircraft if needed to free the aircraft up for further tasking and /or get body and staff out of the heat.

If unsure death is reportable call the Coroner's Delegate on 9425 2900 or 0419 904 478.

For any queries contact the Coroner's Office on 1800 671 994.

Completing a death certificate

1. You must have been the treating (for at least 30 min) doctor during the last illness.
2. You must have a definitive diagnosis. Give the cause of death not the mode of dying. (i.e. not respiratory failure when the patient had pneumonia). Causative organisms should be recorded for infectious diseases and histological diagnosis plus location of primary for neoplastic causes.
3. The cause of death and all contributing factors must be documented.

4. Do not use abbreviations.
5. The death certificate should be handed to the undertaker responsible for the body.
6. Note there is a special perinatal (of at least 20wks gestation or any death in the first 28 days of life) death certificate though in our practice we would refer most of these to the coroner.

Destination of patients who have died in flight

If a patient dies in flight the patient should be returned to the originating hospital or flown on to the destination depending on which is closest and logistically most appropriate.

For patients who have a completed death certificate an undertaker should be contacted, preferably attempt to find out who the family would prefer, otherwise in Cintra Contracting contacted through the coroners office maintain a holding facility. Operations staff should do this to ensure the deceased can be handed over promptly on landing.

Death at referring location and prior departure

Should a death occur in presence of RFDS staff without having actually taken off with the patient, responsibility for notification of coroner or death certification can be passed back to the referring doctor, unless this occurs in a primary location in which case this remains an RFDS responsibility.

Notification of next of kin

The RFDS medical officer certifying life extinct should contact the referring doctor and ask them to notify the next of kin. For primary retrievals this may be more difficult, the RFDS doctor may need to directly notify family, remote area nurse or request the police locate and notify the next of kin. Relatives who are accompanying patients who die in flight should have appropriate explanations, support and assistance offered on arrival.

Deaths in remote locations

It is common to receive calls regarding patients found deceased, or for whom resuscitation is in progress. Ensure BLS/ALS protocols have been followed as appropriate. Follow-up support by telephone after the event is very important to debrief those involved and answer any questions they may have. We do not fly to retrieve deceased persons.

References

1. Turnbull, R. The Coronial Process in Western Australia, A Handbook for Medical Practitioners and Medical Students. Office of the State Coroner. June 2010
2. Bird, S. "How to Complete a Death Certificate, A Guide for GPs." Australian Family Physician Vol 40, No.6. June 2011

17.3 Drug Administration Policy

Theory

The transport environment exposes clinicians to a much greater risk of error in drug administration. High-risk factors include:

1. Communication difficulties (extraneous noise, poor quality reception on satellite phone or radio).
2. Working with unknown practitioners who are unfamiliar with our protocols and procedures.
3. Practicing in isolation with no second pair of eyes to check drugs.
4. Fatigue.
5. Poor lighting.
6. Time critical emergencies.

Pre-flight and In-flight Management

Prescribing

- Where ever possible a written prescription should be made in the preflight assessment for medications, fluids and oxygen.
- There are no standing orders and each patient is expected to have a personalised management plan.
- Prescriptions should include correct drug names (not abbreviations), preparation and concentration, dose / rate, maximum dose, route and indication.
- Verbal prescribing must be clear and include the same information, this should be followed by a written record of this prescription either in the clinical updates section of the pre-flight assessment or by using the remote consultation system and recording the consult number on the observation chart.
- Drugs signed off on the observation chart by a doctor who was on the flight are considered equivalent to a written prescription.
- Orders written up by non-RFDS clinicians or in hospital medical medication charts are not acceptable.

Checking and Labelling

- Drugs drawn up by non-RFDS staff for our use should be cross checked by an RFDS staff member.
- Where two staff members are present both should check the contents of syringe against ampoules for correct medication and diluent, strength and expiry and sign off the label. Extra vigilance and rechecking is required when working solo.
- Labelling should be consistent with national standards as below.



Figure 17.1 Syringes (and small bags with additives)

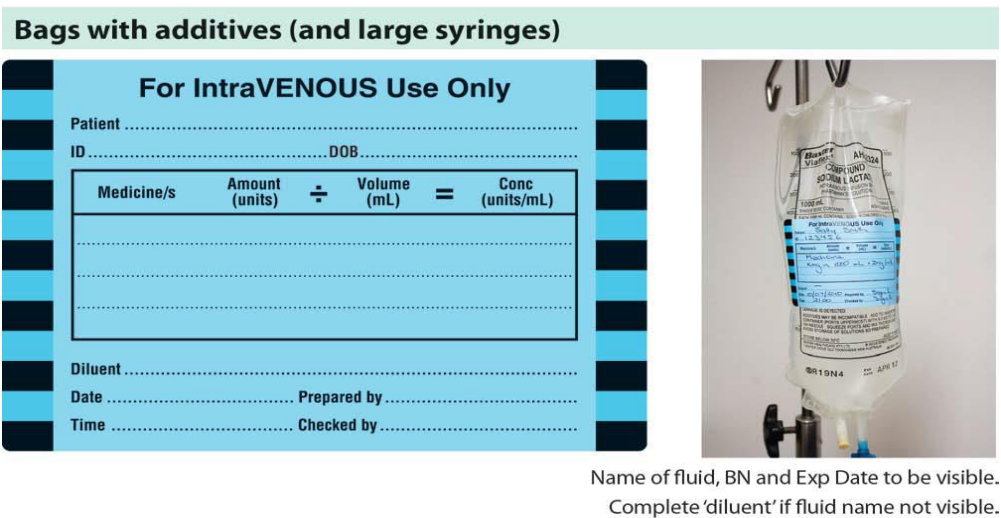


Figure 17.2 Bags with additives (and large syringes)

Coloured labels are available for anaesthetics drugs, these should be used **in addition** to the above additive label when conducting rapid sequence induction. These labels should also be used to label lines when multiple infusions are running.

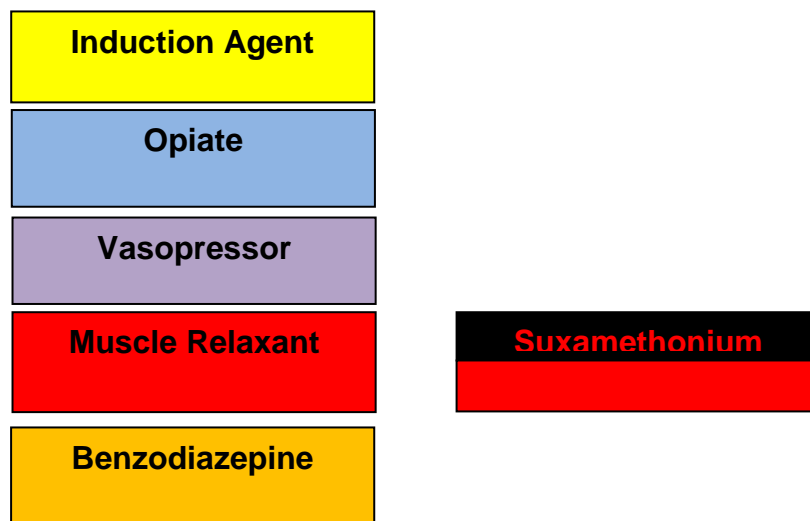


Figure 17.3 Coloured labels for anaesthetic drugs

Remember the 6 Rights of Drug Administration

1. Right Patient
2. Right Drug
3. Right Dose
4. Right Route
5. Right Time
6. Right Documentation

Documentation

- All drugs given should be documented in the In-Flight Observation and Treatment chart.
- No abbreviations are to be used.
- For infusions ensure strength, rate and route are documented.
- Drugs given by bolus or intermittent aliquot should have each increment documented.
- Drugs given in time critical emergencies or rapid sequence induction may need to be documented after the event.
- Take care not to incorrectly use the terms milligrams and millilitres (“mills”)

Medication Stock Management

All aspects of medication stock management are covered in RFDS Western Operations Clinical Operating Procedure Medication Management Documentation.

17.4 Infection Control and Restrictions to Patient Carriage

1. The following patients require a **single stretcher transfer** and some additional infection control precautions. All patients require adherence to standard precautions.
2. No patient shall be placed at risk of death or permanent disability by being denied a flight due to the requirement for a single stretcher transfer. Where there is conflicting demand for a limited resource, escalation to the Clinical Coordinator or Director of Medical Services who may over-ride the requirement for a single stretcher transfer.
3. Assessing doctors should be alert to patients who may potentially require isolation. The infectious status of a patient may not be known at the time of referral.

Infection Control Precautions

Table 17.3 Infection Control Precautions

Contact Spread		
<i>Multi-resistant organisms</i>	<i>Gastro-enteric infections</i>	<i>Contagious skin & eye</i>
VRE MRSA	Viral gastroenteritis Clostridium difficile Campylobacter Cholera Cryptosporidium Salmonella Shigella Hepatitis A, E Poliomyelitis Rotavirus Typhoid	Staph or Strep that cannot be adequately covered by dressings Draining abscess Impetigo with less than 24 hours of treatment Herpes simplex (severe) until lesions dry Viral haemorrhagic conjunctivitis Severe crusted (Norwegian) scabies.
Precautions		
<ul style="list-style-type: none"> • Single stretcher (single patient per flight) 		
<ul style="list-style-type: none"> • Gloves • Gown • Mask[#] only if sputum positive • Eye protection as required for splashes, sprays and aerosol generating procedure 		<ul style="list-style-type: none"> • Equipment must be single use or reprocessed* between patients • Environmental clean* post carriage

Droplet Spread		
Respiratory		Other
Influenza or influenza-like illness (fever $\geq 38^{\circ}\text{C}$ plus cough / sore throat in absence of other cause)	Respiratory syncytial virus (RSV) Pertussis Bronchiolitis	Meningococcal sepsis Norovirus
Precautions		
<ul style="list-style-type: none"> • Single stretcher (single patient per flight) 		
<ul style="list-style-type: none"> • Gloves when potential for contact with blood or body substances • Gown if required for contact with blood or body substances • Mask[#] for both patient and staff (if possible) • Eye protection for aerosol generating procedures (nebuliser, suction, intubation, high flow nasal prongs, non-invasive ventilation) Spacers should be used in preference to nebulisers. 		<ul style="list-style-type: none"> • Single use equipment or reprocess* between patients • No additional passengers (other than parent / guardian of child) • Environmental clean* post carriage

Airborne Spread		
Active pulmonary TB (productive cough, cavitating lesion)		
Varicella (Chicken pox or shingles) unless lesions all dry and crusted.		
Measles		
Precautions		
<ul style="list-style-type: none"> • Single stretcher (single patient per flight) 		
<ul style="list-style-type: none"> • Gloves for potential contact with blood or body substances • Gown as required for contact with blood or body substances • P2 (N95)[#] respirator • Eye protection when potential for splashes or sprays or for aerosol generating procedures (nebuliser, suction, intubation, high flow nasal prongs, non-invasive ventilation). Spacers should be used in preference to nebulisers. 		<ul style="list-style-type: none"> • Single use equipment or reprocess* between patients • No additional passengers (other than parent / guardian of child) • Environmental clean* post carriage

* Refer to Nursing procedures manual

The only mask carried by RFDS is the N95 respirator (the orange duck bill shaped mask) - this is suitable for all mask wearing scenarios.

Staff exclusion criteria

Which staff should be excluded from specific patient transfers?

Some staff may need to be excluded from flights on the basis of their own risk factors.

Table 17.4 Infection Control Precautions

Infection	Staff Risk Factor		
	Non-Immune	Immunosuppressed (Neutropenic, disseminated malignancy, high dose long term steroids, cytotoxic drug)	Pregnant
Varicella-Zoster Virus	Yes	Yes	Yes
CMV		Yes	Yes
Hep A	Yes		
Hep B	Yes		
Hep E			Yes
HSV		Yes	
Influenza	Yes	Yes	Yes
Measles	Yes	Yes	Yes
Mumps	Yes		
Pertussis	Yes		Yes
Polio	Yes		
RSV		Yes	
Rubella	Yes		Yes
Scabies		Yes	
TB		Yes	

* All these infections have vaccinations available and staff should have their vaccination status known at pre-employment medical. RFDS offers annual influenza vaccination to relevant staff.

Staff infected with any of the above should exclude themselves from the work place until medically cleared to return.